

The dietary quality of food pantry users from a socio-ecological perspective

**Dissertation to obtain the doctoral degree of Natural Sciences
(Dr. rer. nat.)**

Faculty of Natural Sciences
University of Hohenheim
Institute of Nutritional Medicine

submitted by
Anja Simmet
from Soltau
2019

Date of the oral examination: 09/12/2019

Faculty Dean: Prof. Dr. Uwe Beifuss

Supervisor: Prof. Dr. Nanette Ströbele-Benschop

Second Reviewer: Prof. Dr. Sarah Egert

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Abbreviations

%	percentage
β	beta coefficient
cf.	Latin: confer/conferatur, English: compare
CVD	cardiovascular disease
e.g.	Latin: exempli gratia, English: for example
F&V	fruit and vegetables
GIS	geographic information system
i.e.	Latin: id est, English: that is
LMA	Lebensmittelausgabestellen
M	mean
NLMA	Nutzer/innen von Lebensmittelausgabestellen
p	probability
SEM	Social Ecological Model
t	t-test
TE	Transferleistungsempfänger/innen
UK	United Kingdom
USA	United States of America

Abstract

In Germany, around 1.5 Mio people with a low income receive food for a small fee from one of around 940 so-called “Tafel”. In high-income countries like Germany, users of food pantries are a particularly vulnerable population group, as they are characterized by cumulative health risks. They often suffer from food insecurity and from chronic diseases such as hypertension, diabetes mellitus type 2 or obesity. Given that these diseases as well as food insecurity both relate to diet, the dietary quality plays a critical role in the health status of food pantry users. To illustrate the dietary quality and the different levels of factors influencing the dietary quality among food pantry users, this thesis has the following aims:

1. to provide a summary of the scientific evidence about the dietary quality of food pantry users in high-income countries;
2. to provide a summary of the scientific evidence about the nutritional quality of food provided by food pantries in high-income countries;
3. to examine the distribution of Tafel food pantries and food banks and to provide a representative picture of their resources (e.g. food, volunteers etc.), activities (e.g. provided programs) and users in Germany;
4. to examine the distribution of Tafel food pantries and to identify compositional and physical environmental correlates of food pantry use in Berlin.

To reach these aims, two systematic reviews were conducted (first and second publication). In addition, an explorative cross-sectional study consisting of an analysis of secondary data and a comprehensive survey among all Tafel belonging to the federal association “Tafel Deutschland” was performed (third publication). Finally, an ecological study was conducted by analyzing and mapping food pantry use and compositional and physical characteristics of areas in Berlin (fourth publication).

The first review revealed that the dietary quality among the reviewed food pantry users tended to be low as reflected by an inadequate intake of energy, fruit and vegetables, dairy products and calcium compared to national recommendations. The reviewed food pantry users had, in particular, a lower consumption of dairy products compared to the general populations. The second review demonstrated that the nutritional quality of reviewed pre-packed food bags provided by food pantries was highly variable within and between included studies. It also showed that the nutritional quality of most of the food bags was low, reflected, in particular, by a low provision of dairy products, vitamins A and C and calcium compared to national recommendations. None of the studies included in the reviews were nationally representative.

The third publication showed that the German food bank system Tafel Deutschland provided a comprehensive net of food pantries, social supermarkets, food banks and other services. However, the number of Tafel per 10,000 welfare recipients was lower in eastern Germany ($M = 1.37$) compared to western Germany ($(M = 2.12)$, $t(162.54) = 4.2424$, $p < 0.0001$). In contrast to the results of the studies

included in the second review, the Tafel mainly provided perishable food such as fruits and vegetables (41.42% of the amount of food distributed), bakery products (19.85%) and dairy products (13.39%). However, due to the dependence on donors such as retailers, the amount of food distributed varied widely. The assistance of most local Tafel is based on volunteer labor as 89.97% of Tafel's staff were volunteers. In 79 districts, in which all Tafel participated in the survey, there was an average of 179 Tafel beneficiaries per 1000 welfare recipients and 17 Tafel beneficiaries per 1000 residents overall. An even lower usage was found by the fourth publication which revealed that only two out of 1000 adult inhabitants and six out of 1000 children received assistance from one of the 44 investigated Tafel food pantries in Berlin. Tafel use by adults (A) or by children (B) was related to the percentage of welfare recipients (A, $\beta = 0.17$, $p < 0.001$ und B, $\beta = 0.16$, $p = 0.002$), the percentage of inhabitants with migration background (A, $\beta = -0.08$, $p = 0.002$), the number of discount grocery percentage stores per 1000 children (B, $\beta = 5.65$, $p = 0.010$), and the number of stops of the public transport within a radius of 500 meters (A, $\beta = -0.24$, $p = 0.020$). The most important limitation of both studies was the unknown reliability of the data collected from the Tafel.

The dietary quality of food pantry users in high-income countries was seen to be low. Although food pantries did not provide a full meal plan for a healthy diet, they may have a positive impact on the dietary quality of its users. However, to better understand the role of food pantries in the complex interplay of individual, social and environmental influences on the diet of food pantry users, multi-level approaches should be used in the future. Moreover, researchers are strongly recommended to investigate the mechanisms by which using a food pantry might impact users' dietary quality. In addition to these implications for researchers, this thesis makes several recommendations to practitioners at food pantries in Germany and other high-income countries. Following these recommendations could make the position of food pantries in civil society into an important entry point for health promotion among a part of the food insecure population in the future.

Zusammenfassung

Allein in Deutschland erhalten regelmäßig etwa 1,5 Mio. Menschen mit einem niedrigen Einkommen gegen einen geringen Beitrag Lebensmittel von einer der rund 940 Tafeln. Nutzer/innen solcher Lebensmittelausgabestellen (NLMA) stellen eine besonders vulnerable Bevölkerungsgruppe dar, da sie von kumulativen Gesundheitsrisiken betroffen sind. So haben sie im Vergleich zu anderen Bevölkerungsgruppen mit einem niedrigen Einkommen ein höheres Risiko von Ernährungsunsicherheit betroffen zu sein. Zudem leiden sie häufig an ernährungsassoziierten Erkrankungen wie Adipositas, Diabetes mellitus Typ 2 und/oder Hypertonie. Daher kommt dem Ernährungsverhalten eine besondere Bedeutung für die Gesundheit von NLMA zu. Um die Ernährungsqualität von NLMA und die unterschiedlichen Einflussebenen auf die Ernährung der NLMA zu illustrieren, ergaben sich für die vorliegende Arbeit folgende Ziele:

1. Eine Zusammenfassung der wissenschaftlichen Evidenz zu der Ernährungsqualität von NLMA in Hocheinkommensländern zu bieten,
2. Eine Zusammenfassung der wissenschaftlichen Evidenz zu der Nährwertqualität der von LMA in Hocheinkommensländern angebotenen Lebensmittel zu bieten,
3. Die Verteilung der Tafeln in Deutschland zu untersuchen und ein repräsentatives Abbild der Ressourcen (z.B. Lebensmittel, Freiwillige), Aktivitäten (z.B. angebotene Programme) und Nutzer/innen der Tafeln zu bieten
4. Die Verteilung der LMA der Berliner Tafel e.V. zu untersuchen und kompositionelle und strukturelle Korrelate der Nutzung der LMA in Berlin zu identifizieren.

Um diese Ziele zu erreichen, wurden zwei systematische Reviews (erste und zweite Publikation), eine Querschnittstudie bestehend aus der Analyse sekundärer Daten und einem umfangreichen Survey (dritte Publikation) sowie eine ökologische Querschnittstudie (vierte Publikation) durchgeführt.

Gemäß der in dem ersten Review inkludierten Studien ist die Ernährungsqualität von NLMA in Hocheinkommensländern insbesondere durch einen verglichen mit nationalen Empfehlungen unzureichenden Verzehr von Obst und Gemüse, Milchprodukten und Kalzium charakterisiert. Im Vergleich zu der Allgemeinbevölkerung berichteten die untersuchten NLMA insbesondere einen niedrigeren Verzehr von Milchprodukten. Die in dem zweiten Review inkludierten Studien zeigten, dass die in den von LMA in Hocheinkommensländern angebotenen, in der Regel vorsortierten Lebensmittel-Körbe enthaltenen Energie- und Nährstoffmengen sowohl innerhalb einer Stichprobe als auch zwischen den Stichproben starken Schwankungen unterliegen. Die meisten Körbe enthalten im Vergleich zu nationalen Empfehlungen insbesondere unzureichende Mengen an Milchprodukten, Vitamin A und C sowie Kalzium. Allerdings war keine der in einem der beiden Reviews inkludierten Studienstichproben auf nationaler Ebene repräsentativ.

Die dritte Publikation zeigte, dass Tafel Deutschland über ein deutschlandweites Netz an Lebensmittelbanken, -ausgabestellen, sozialen Supermärkten und anderen Services verfügt, die Dichte

der Tafeln je 10 000 Transferleistungsempfänger/innen (TE) in Ostdeutschland jedoch niedriger ($M = 1,37$) als in Westdeutschland ($M = 2,12$) ist ($t(162,54) = 4,2424$, $p < 0,0001$). Anders als viele LMA in anderen Hocheinkommensländern (zweite Publikation), verteilen die Tafeln überwiegend frisches Obst und Gemüse (41,42% der verteilten Lebensmittelmenge), Backwaren (19,85%) und Milchprodukte (13,39%). Aufgrund der Abhängigkeit der Tafeln von Spendern ist das Lebensmittelangebot der Tafeln starken Schwankungen unterworfen. Insgesamt sind 89,97% der Tafel-Mitarbeitenden Freiwillige. Basierend auf Daten von 79 Landkreisen, in denen alle Tafeln an dem Survey teilnahmen, ergab die Studie eine durchschnittliche Nutzeranzahl von 179 Nutzer/innen pro 1000 TE bzw. 17 Nutzer/innen je 1000 Einwohner/innen. Eine noch niedrigere Nutzungsrate wurde durch die vierte Publikation aufgedeckt, die aufzeigte, dass lediglich zwei von 1000 Erwachsenen und sechs von 1000 minderjährigen Einwohner/innen Lebensmittel von einer der 44 untersuchten LMA der Berliner Tafel e.V. erhalten. Multiple Regressionsmodelle zeigten, dass die LMA-Nutzung von Erwachsenen (A) bzw. Kindern (B) signifikant mit dem Anteil der TE (A, $\beta = 0,17$, $p < 0,001$ und B, $\beta = 0,16$, $p = 0,002$), dem Anteil der Einwohner/innen mit Migrationshintergrund an der Wohnbevölkerung (A, $\beta = -0,08$, $p = 0,002$), der Anzahl der Discounter je 1000 Kinder (B, $\beta = 5,65$, $p = 0,010$) und der Anzahl an Haltestellen des öffentlichen Personennahverkehrs innerhalb eines Radius von 500 Metern um eine LMA (A, $\beta = -0,24$, $p = 0,020$) zusammenhängt. Die wichtigste Einschränkung beider Originalstudien ist die unbekannte Reliabilität der Daten, die von den Tafeln erhoben wurden.

Ogleich LMA keine Vollversorgung im Sinn einer ausreichenden Lebensmittelmenge für eine gesunde Ernährung bieten, könnten sie die Ernährung der NLMA positiv beeinflussen. Um die Rolle der LMA in dem komplexen Wechselspiel zwischen individuellen, sozialen und umweltbezogenen Einflussfaktoren der Ernährung besser zu verstehen, sind Mehrebenen-Ansätze notwendig. Zudem wird eine detailliertere Untersuchung der Mechanismen, über die eine LMA-Nutzung auf die Ernährung einwirkt, empfohlen. Würden die in dieser Arbeit herausgegebenen Empfehlungen für Mitarbeitende in LMA umgesetzt, könnten sich LMA zukünftig als wichtige zivilgesellschaftliche Gesundheitsförderer für einen Teil der ernährungsunsicheren Bevölkerung etablieren.

Preliminary notes

Parts of this research work presented in this thesis were published previously in peer-reviewed journals or were presented at international conferences as poster presentations. The scientific work was partially conducted in cooperation with co-authors from the University of Hohenheim and the Charité University Medical Center, Berlin.

Articles in peer-reviewed journals

Simmet A, Depa J, Tinnemann P, Stroebele-Benschop N. The Dietary Quality of Food Pantry Users: A Systematic Review of Existing Literature. *J Acad Nutr Diet.* 2017;117(4):563-576. doi:10.1016/j.jand.2016.08.014

Anja Simmet conceptualized the review, completed the searches, the abstract / full text screening, data extraction and quality assessment, drafted and revised the manuscript. Julia Depa duplicated the full text screening, data extraction and quality assessment. Dr. Peter Tinnemann proofread the original manuscript and Prof. Dr. Ströbele-Benschop supervised the work, made the final decision if no agreement could be reached between Anja Simmet and Julia Depa on the inclusion of reviewed studies, proofread and revised the original manuscripts.

Simmet A, Depa J, Tinnemann P, Stroebele-Benschop N. The Nutritional Quality of Food Provided from Food Pantries: A Systematic Review of Existing Literature. *J Acad Nutr Diet.* 2017;117(4):577-588. doi:10.1016/j.jand.2016.08.015

Anja Simmet conceptualized the review, completed the searches, the abstract / full text screening, data extraction and quality assessment, drafted and revised the manuscript. Julia Depa duplicated the full text screening, data extraction and quality assessment. Dr. Peter Tinnemann proofread the original manuscript and Prof. Dr. Ströbele-Benschop supervised the work, made the final decision if no agreement could be reached between Anja Simmet and Julia Depa on the inclusion of reviewed studies, proofread and revised the original manuscripts.

Simmet A, Tinnemann P, Stroebele-Benschop N. The German Food Bank System and Its Users-A Cross-Sectional Study. *Int J Environ Res Public Health.* 2018;15(7). doi:10.3390/ijerph15071485

Anja Simmet conceptualized the study, conducted the data assessment, performed the statistical analyses, wrote and revised the original draft. Dr. Peter Tinnemann supervised the study and revised the manuscript, and Prof. Dr. Ströbele-Benschop supervised the study and provided feedbacks and contributions to the drafts of the publication.

Simmet A, Stroebele-Benschop N, Tinnemann P. Area characteristics associated with food pantry use in Berlin – A cross-sectional ecological study. *Appl Geogr.* 2017;89:87-99. doi:10.1016/j.apgeog.2017.10.005

Anja Simmet conceptualized the study, performed the geographical and statistical analyses, and wrote and revised the original draft. Prof. Dr. Ströbele-Benschop and Dr. Peter Tinnemann supervised the study and revised the manuscript.

Published during the preparation of this work, but not part of this thesis:

Book chapter

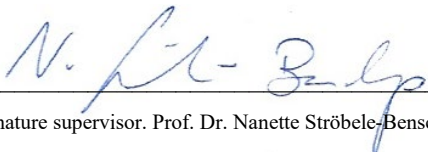
Stroebele-Benschop N, **Simmet A**, Depa J. Nutrition Status of Those Receiving Unprepared Food from Food Banks: Overview of Food Bank Users in High-Income Countries and Their Diet. In: Preedy V, Patel VB, eds. *Handbook of Famine, Starvation, and Nutrient Deprivation: From Biology to Policy*. Cham: Springer International Publishing; 2017:1-22. doi:10.1007/978-3-319-40007-5_10-1

Article in a peer-reviewed journal

Simmet A, Stroebele-Benschop N. Creating healthy food pantries by using behavioural economics approaches. *Public Health Nutr.* 2019:1-3. doi:10.1017/S136898001900079X

Stuttgart, 17.06.2019

Date


Signature supervisor. Prof. Dr. Nanette Ströbele-Benschop

Chapter 1

Introduction

1.1 Foreword

In high-income countries, both the risk of common diseases such as diabetes mellitus type 2¹ (in the following: diabetes mellitus) and cardiovascular disease (CVD)^{2,3} as well as the risk of pre-mature mortality^{4,5} follow a socioeconomic gradient and are highest among low-income and deprived individuals. In Germany the life expectancy of men in the lowest income group is 10.8 years less than men in the highest income group.⁶ The difference in life expectancy between women in the lowest income group compared to those in the highest income group amounts to 8.4 years.⁶ Inequalities in mortality⁷ and diseases such as diabetes mellitus or obesity⁸ have also been mirrored by geographic variations in these health outcomes. For instance, districts in the quintile with the highest deprivation assessed by an index called German Index of Multiple Deprivation showed a significantly higher risk of total mortality as well as premature mortality compared to the districts in the wealthiest quintile in Germany in 2010.⁷ Such regional disparities likely have implications not only for the inhabitants living in deprived places, but also for scientists and other professionals attempting to understand the root causes of such variations and their interactions.

Population-based studies aiming to understand health disparities often fail to include some of the most disadvantaged populations.^{9,10} One of these underrepresented disadvantaged groups with low income are users of food pantries. The following sections illustrate in more detail how users of food pantries disproportionately face a higher cumulative health risk.¹¹⁻¹³ For instance, food pantry users in Germany¹⁴ and other high-income countries¹⁵⁻¹⁷ are at high risk of being food insecure (see explanation box 1), even compared to other low-income population groups.^{15,18} In addition, studies of food pantry users in these countries found a high prevalence of being overweight, obesity¹²⁻¹⁵ and other chronic diseases such as hypertension and diabetes mellitus.¹¹⁻¹³ In a recent study in three cities in Germany (Berlin, Ludwigsburg, Fulda), diabetes mellitus was twice as prevalent among the participating food pantry users than among the general population with low socioeconomic status.¹¹ Given that food insecurity^{19,20} and most of the common diseases observed among food pantry users^{21,22} are related to diet, the dietary quality (see explanation box 2) among food pantry users plays a critical role of their health status. Differences in dietary behavior may also contribute to the health differences across the socioeconomic gradient in general²³ and between food pantry users and the general population with low socioeconomic status in particular. For instance, the aforementioned German study observed lower fruit consumption among food pantry users than among the general population with low socioeconomic status.¹¹

Explanation box 1. Definition of food insecurity

“Food insecurity exists whenever the availability of nutritionally adequate and safe foods or the ability to acquire acceptable foods in socially acceptable ways is limited or uncertain.”²⁴

By contrast, food security is the “access by all people at all times to enough food for an active, healthy life. Food security includes at a minimum: (1) the ready availability of nutritionally adequate and safe foods, and (2) an assured ability to acquire acceptable foods in socially acceptable ways (e.g., without resorting to emergency food supplies, scavenging, stealing, or other coping strategies).”

²⁴ Experiences with food insecurity vary on a “continuum of stages as the condition becomes more severe.”²⁵ It typically ranges from worrying about running out of money for food to limiting the diversity and quality of food to restricting the consumption of food.²⁶

From this perspective, food insecurity encompasses the four dimensions food access, availability, utilization, and stability over time and refers to self rated experiences.²⁷ Although well established assessment instruments exist that include cognitive as well as affective components,^{27,28} none of the tools available to measure food insecurity assess all four dimensions.²⁷

In addition to a strong influence on individual’s diet,^{19,20} household food insecurity has repeatedly been shown to be associated with poorer physical, mental and social health including obesity and depression.^{29–31}

The term “food poverty” is similar to “food insecurity” and has been defined in various ways, for instance as “the inability to afford or have reasonable access to food which provides a healthy diet”³² and/or, very similar, as the “inability to have an adequate and nutritious diet due to issues of the affordability of and access to food”.³³ Although “food poverty” may be understood as a similar multidimensional phenomenon as food insecurity, there appears to be no standardized measurement tool for food poverty.

Explanation box 2. Definition of dietary quality

Although the terms “dietary quality”, “healthy diet”, and “nutritious food” are widespread, they are not clearly defined.³⁴ The World Health Organization emphasizes that “a healthy diet helps to protect against malnutrition in all its forms, as well as noncommunicable diseases (NCDs), including such as diabetes, heart disease, stroke and cancer”,³⁵ i.e. one function of a healthy diet is the prevention of diseases. In the last years, research has focused on food components with additional health functions and to diets that are adapted to the individual needs to reach optimal health,³⁶ i.e. another function of a healthy diet is promoting health. Alkerwi understands diet quality as an “umbrella term frequently used to describe how well an individual’s diet conforms to dietary recommendations.”³⁴

By measuring the dietary quality, researchers have attempted to evaluate the risk of certain diseases such as cancer³⁷ or CVD mortality,^{38,39} i.e. measurements of the dietary quality are used as a risk

assessment tool (cf. Alkerwi³⁴). Several indices have been developed as summary measures of overall dietary quality (for a review of diet quality tools, see, for instance Wirt and Collins⁴⁰). These indices assess either the adherence to national recommendations such as the Health Eating Index,⁴¹ the Healthy Food Index,⁴² and the Diet Quality Index-international⁴³ or the adherence to a priori determined diets such as the Mediterranean Diet Score.⁴⁴ Most indices capture two up to four components including adequacy, i.e. a sufficient amount of nutrients and/or food groups compared to national recommendations, variety within and across food groups, moderation, i.e. limiting foods that contribute to an enhanced risk of disease, and overall balance, i.e. the composition of macronutrient intake in relation to energy intake.^{34,43} Alternatively, posterior approaches aim to identify dietary patterns by applying factor or cluster analysis.⁴⁵

In this thesis, the term “dietary quality” is used to describe the degree of adherence of individual’s or population’s diet to national dietary recommendations. Although the intake of energy, single food groups or nutrients compared to dietary reference values or recommendations does not reflect the overall dietary quality, it is used to evaluate the probability of an adequate intake of energy or the food groups or nutrients under study (cf., for instance, the German Nutrition Society⁴⁶). It should, however, be recognized that the dietary recommendations do not reflect a person’s individual requirements (cf., for instance, the German Nutrition Society⁴⁶).

Similarly, the term “nutritional quality” is used to describe the dietary content of food bags provided by food pantries compared to national dietary recommendations.

It has widely been recognized that dietary behavior is highly complex and the result of diverse interacting influences; it cannot only be explained by individual factors.⁴⁷

Socio-ecological approaches illustrate different levels of influence and have been used to describe multifaceted, interacting impacts of the individual, social and environmental level on dietary behavior.⁴⁷ The Social Ecological Model (SEM) of McLeroy et al. proposed five levels of influence: intrapersonal factors (e.g. attitudes, beliefs, and knowledge), interpersonal factors (e.g. formal and informal social networks), organizational factors (e.g. organization characteristics including rules, regulations and policies), community factors (e.g. community norms, built environments) and finally, public policy (e.g. local, state, national and international laws and policies) (Figure 1).⁴⁸ One of the key concepts of the SEM is the reciprocal causation, i.e. that health behavior shapes and is shaped by the social and built environments.⁴⁸

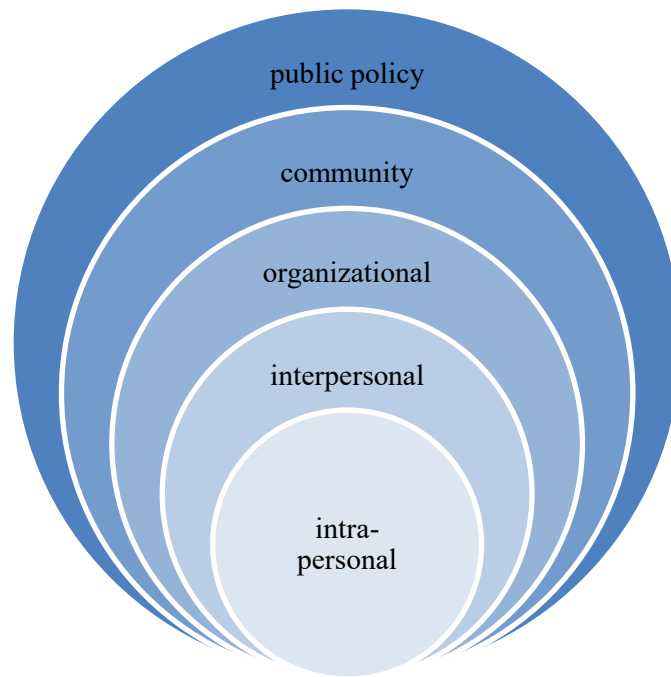


Figure 1. The Social Ecological Model, adapted from “An ecological perspective on health promotion” by McLeroy KR, Bibeau D, Steckler A, Glanz K, 1988.⁴⁸

In the context of the dietary behavior of food pantry users, an ecological perspective emphasizes that their food consumption is also determined by factors that are beyond their individual control. For instance, the nutritional quality of groceries provided by aid organizations, their policies and/or distribution systems likely also influence beneficiaries’ diets directly or indirectly.⁴⁹ The nutritional quality of the food provided by a food pantry might in turn be influenced by factors at “higher” levels such as state, national, and supranational laws and regulations. The pantries’ operations are also determined by factors at “lower” levels such as the demand of food pantry users. Although socio-ecological approaches have been adapted to diverse contexts and behaviors such as school-based physical activity⁵⁰ or adolescents’ screen time and sedentary behavior,⁵¹ so far they have not been used to identify and comprehensively describe factors impacting the dietary quality of food pantry beneficiaries.

This thesis aims to illuminate the dietary quality and the different levels of influencing factors of the dietary quality among food pantry users in high-income countries. This introductory chapter is separated in five parts. First, food pantries and food banks will be defined and distinguished from other charitable food programs. Then, the broader socio-political context in which the number of food pantries and food banks has increased will be presented. Next, food pantries will be positioned in the food environment of low-income population groups. After that, food pantry users will be characterized. Finally, the research gaps will be identified and the specific aims of this thesis will be presented.

1.2 Food pantries and food banks

Since the first so-called “food bank” (see explanation box 3) was founded in 1967 in Phoenix in the USA,⁵² various food banks have been established all over the world, organized in several local, national and international such as the “European Food Banks Federation”,⁵³ “Food banks Canada”,⁵⁴ “Feeding America”⁵⁵ and “The Global FoodBanking Network”.⁵⁶

Explanation box 3. Definitions of food banks and food pantries

As defined by the Global FoodBanking Network, “food banks acquire donated food, much of which would otherwise be wasted, from farms, manufacturers, distributors, retail stores, consumers, and other sources, making it available to those in need through an established network of community agencies. These agencies include school feeding programs, food pantries, soup kitchens, AIDS and TB hospices, substance abuse clinics, after-school programs, and other nonprofit programs that provide food to the hungry.”⁵⁶ In contrast, food pantries are defined as the entities that distribute the donated food to the end users.⁵⁷

Other charitable food organizations include soup kitchens where people receive a prepared meal to consume on site or consume at home⁵⁸ and social supermarkets, which sell food at a greatly reduced price to people with low income.⁵⁹ In Germany, no distinction is made between food banks, food pantries and social supermarkets and all of these schemes are called “Tafel” and collaborate under the umbrella of the federal association called “Tafel Deutschland e.V.” (previously “Bundesverband Deutsche Tafel e.V.”).⁶⁰

Whereas in countries outside the USA, the terms “food banks” and “food pantries” or also “food aid” and “food parcel programs” are used interchangeably or only one term such as “food banks” is used,⁶¹ in this thesis the terms “food banks” and “food pantries” are used as defined by the Global FoodBanking Network⁵⁶ and Feeding America,⁵⁷ except for the original publications where the definitions of the publisher’s national food bank association were used.

The size, distribution schemes, eligibility criteria, operational organization, financial and food sourcing of food pantries and food banks vary substantially between and even within high-income countries.^{62–64}

Distribution schemes include food banks, food pantries and social supermarkets as defined above.^{62,63} Some food pantries provide pre-packed bags, whereas others allow clients to choose the foods they prefer.^{65,66} Applied eligibility criteria ranges from none to very strict requirements, whereby many food pantries and food banks including the Tafel in Germany use an income cut-off to define eligibility.^{62,67} The German Tafel are allowed to distribute donated food only,⁶⁸ whereas food pantries and food banks in other countries such as in the USA are allowed to purchase food that they need to

complete their assortment of products.⁶³ Many food pantries in the USA and Canada intend to provide enough food for a certain number of days,^{63,69} whereas the Tafel in Germany claim to provide food to supplement the beneficiaries' usual diet, i.e. the food bought in commercial food stores.⁶⁸ Despite these varieties, the common characteristic of food pantries is that they regularly distribute food at a low cost or for free to people with a low or no income.

In contrast to food pantries and food banks in other high-income countries such as the USA,⁶³ Canada⁶² or Australia,⁷⁰ the Tafel in Germany have so far not scientifically been investigated.

1.2.1 The evolution of food pantries

As described above food pantries and food banks initially emerged to provide infrequent emergency food aid to individuals suffering economic hardships.⁷¹ Over time, they have, however, evolved as a regular source of food for many people^{12,13,15,72} and most food pantries in high-income countries repeatedly report constant high or even increasing numbers of individuals seeking assistance from their programs.^{63,73,74} For instance, in Germany, the federal Tafel association estimated that around 1.5 million adults and children were supported by a local Tafel pantry in 2017.⁷⁵

Previous studies show that the demographic profile of food pantry users in Germany⁷⁶ and elsewhere^{12,77,78} tend to mirror characteristics that can increase the risk of food insecurity with a major proportion of the clientele being unemployed, earning low wages or, in particular, being reliant on social assistance (see chapter 1.3).

Therefore, the rise in the number food pantry users has repeatedly been interpreted as failure of the public welfare system to prevent food insecurity.^{78–80} This interpretation has been discussed not only in Germany with its comparatively strong social services,⁸¹ but also in other high-income countries applying diverse systems of public welfare such as in the USA,⁷⁹ Canada⁷⁸ and the UK.⁸⁰ Several papers demonstrated the temporal relationship between social policy reforms with more restricted eligibility criteria for social assistance and reduced benefit levels as well as the growth of food banks and food pantries.^{78–81} However, very few studies have investigated the spatial relationship between indicators of deprivation like the number of welfare recipients and the number of food pantry users at area-level.⁸²

1.2.2 Food pantries as parts of the food environment

Food pantries and food banks have evolved into important parts of the food environment (see explanation box 4) of low-income population groups.⁸²

Explanation box 4. Definition of food environment

The term food environment describes “physical, social, economic, cultural, and political factors that impact the accessibility, availability, and adequacy of food within a community or region.”⁸³

As illustrated above, health behaviors including diet interact with these wider factors which are beyond the individual control.

In some high-income countries, the food environment has become a rapidly increasing research topic in recent years. The development of user-friendly commercial applications of geographical information systems (GIS) has driven a myriad of studies e.g. in the USA and the UK on the availability of F&V^{84,85} or healthy food assessed by a healthy food availability index⁸⁶ and access to food (e.g. distance, number, and type of grocery stores)^{87,88} and the relationship to neighborhood characteristics such as mean income and the population's race. However, in other areas of the USA⁸⁹ and the UK⁹⁰ as well as in Australia⁹¹ minimal or no differences or the exact opposite have been observed, i.e. deprived areas had the greatest access to F&V. One of the few German food environment studies found that availability of grocery stores did not differ across various socioeconomic characteristics in the city of Berlin.⁹²

Access to commercial food sources has frequently been examined in some high-income countries,^{87,88} but very few studies investigated the distribution of food pantries, and most of these studies were conducted in the USA.^{82,93} The nutritional quality of food provided by food pantries has been examined more often,^{69,94,95} but a scientific summary of the nutritional quality of food provided by food pantries is still missing.

1.3 Food pantry users

Although not all food pantries apply an income eligibility criteria,^{62,63} users usually have a low income.^{11,15,65} In Germany¹¹ and other high-income countries,^{13,63} many studies using probability or random sampling reported that the large majority of participating food pantry users relied on public welfare, whereas fewer studies focused on “the working poor”, i.e. users with an income that does not meet a household's food needs,^{71,96} or on university students.^{97,98} In contrast to many users of soup kitchens or other programs providing prepared meals,^{99,100} users of food pantries usually live in non-transient houses such as apartments.^{13,63,101} Many of them reported suffering from diverse hardships such as loss of public benefits, domestic violence or a disruption in utilities such as telephone service.¹⁰²

Age ranges, household size and composition, ethnicity as well as educational background of food pantry users varied widely between the studied samples (cf., for instance,^{11–17,63,101,103–105}). For instance, reported mean ages range from around 30 years¹⁰¹ to 45 to 55 years.^{12,14,103} Some studies reported large percentages of single mothers^{101,105} or singles without children.^{14,17} Whereas in some samples of food pantry users the most common educational background was a high school degree or similar,^{12,17,63,101} other studies reported that the majority of food pantry users had a middle^{14,15} or low educational background.^{11,103}

Despite this heterogeneity, the most important common characteristic of food pantry users in Germany¹⁴ and other high-income countries^{15–17} is their high risk of being food insecure and having at least one chronic disease as outlined above. Moreover, studies among food pantry users found a high prevalence of smoking.^{11,15,106}

1.4 Research gaps and aims of this thesis

The previous sections characterize food pantry users in high-income countries as a vulnerable population group at the lower end of the socioeconomic gradient and with a high risk of being food insecure and as having at least one chronic disease. The dietary quality of food pantry users is likely an important modifiable determinant of their health. However, summarized evidence about the dietary quality among food pantry users is still missing.

Moreover, the previous sections illustrate potential determinants of the dietary quality at the diverse levels of influence among food pantry users in Germany and other high-income countries.

At the level of intraindividual factors, food pantry users have diverse educational backgrounds, mostly lived in non-temporary housing, have a low income and are unemployed.

At the level of interindividual factors, the available literature reveals that many food pantry users are singles or single parents.

At the level of organizational factors, the literature shows that food pantries and food banks are very heterogeneous. In contrast to food pantries and food banks in other high-income countries, the German Tafel system has so far not been scientifically investigated and a representative picture of structures (e.g. distribution, organization), activities (e.g. supply programs), resources (e.g. volunteers, donated food), and users is still missing. Furthermore, studies on the availability of (healthy) food in commercial food stores have been synthesized by well-conducted reviews, but a summary of the evidence about the nutritional quality of food provided by food pantries is still lacking.

At the level of the community, it becomes clear that the food environment of food pantry users may consist of grocery stores and food pantries. Research on the relationship between deprivation measures and access to commercial food stores is inconclusive, and there are only few studies from the USA investigating the access of low-income people to food pantries

Finally, at the level of public policy, social welfare systems vary in high-income countries as does food pantry users' inclusion in public programs. Despite this diversity, the number of food pantry users has increased in all of these countries and there seems to be a temporal relationship between welfare reforms restricting eligibility criteria coupled with reduced benefits on the one side and an increase in the number of food pantry users on the other side. However, little is known about the spatial relationship between the number of welfare recipients and the number of food pantry users.

Based on the identified research gap, this thesis has the following research aims:

1. to provide a summary of the scientific evidence about the dietary quality of food pantry users in high-income countries;
2. to provide a summary of the scientific evidence about the nutritional quality of food provided by food pantries in high-income countries;
3. to examine the distribution of Tafel food pantries and food banks and to provide a representative picture of Tafel resources (e.g. food, volunteers etc.), activities (e.g. provided programs) and users in Germany;
4. to examine the distribution of Tafel food pantries and to identify compositional and physical environmental correlates of food pantry use in Berlin.

To reach the first aim, a systematic literature review of cross-sectional, cohort, and intervention studies reporting baseline data conducted in high-income countries and published between 1980 and 2015, which reported on nutritional adequacy of individuals who have used a food pantry at least once in the previous 12 months was performed. Similarly, a systematic literature review was performed to achieve the second aim. The review included cross-sectional, cohort, and intervention studies reporting baseline data conducted in high-income countries and published between 1980 and 2015, which reported the nutritional quality of food bags distributed by food pantries was performed. To achieve the third aim, an explorative cross-sectional study consisting of an analysis of secondary data and a comprehensive survey of all Tafel belonging to the federal association Tafel Deutschland was carried out. Finally, an ecological study was conducted by analyzing and mapping food pantry use and compositional (e.g. number of welfare recipients, number of inhabitants with migration background) and physical characteristics (e.g. availability of discount grocery stores, availability of stops of the public transport) of areas in Berlin.

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Chapter 2

The dietary quality of food pantry users: a systematic review of existing literature

Simmet A, Depa J, Tinnemann P, Stroebele-Benschop N.

J Acad Nutr Diet. 2017;117(4):563-576. doi:10.1016/j.jand.2016.08.014



The Dietary Quality of Food Pantry Users: A Systematic Review of Existing Literature

Anja Simmet, Dipl.-Ges.oec.*; Julia Depa, MSc; Peter Tinnemann, MD, MPH; Nanette Stroebele-Benschop, PhD

ARTICLE INFORMATION

Article history:

Submitted 11 December 2015
Accepted 18 August 2016
Available online 7 October 2016

Keywords:

Dietary quality
Food insecurity
Poverty
Food bank
Charitable food assistance

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<http://dx.doi.org/10.1016/j.jand.2016.08.014>

*Dipl.-Ges.oec. is a German degree comparable with the international MSc.

ABSTRACT

Background Users of food pantries often have a long history of food insecurity and may be vulnerable to nutritional deficiencies. The quality of their diets is not well researched. **Objective** The purpose of this systematic review was to summarize the published evidence about the dietary quality of food pantry users.

Methods Systematic database searches of PubMed, PsycINFO, PsycARTICLES, and Psychology Behavioral Sciences Collection, and hand searches of references were conducted to identify cross-sectional, cohort, and intervention studies reporting baseline data, conducted in high-income countries and published between 1980 and 2015, which reported on the nutritional adequacy of individuals who have used a food pantry at least once in the previous 12 months. All identified citations were screened and independently assessed for eligibility. Results for dietary quality were summarized for overall diet quality, energy, food groups, macro- and micronutrients separately. The risk of bias of included studies was evaluated by using criteria of an adapted Ottawa Scale. The systematic review was reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement.

Results After applying predefined eligibility criteria, 16 articles were identified for inclusion. The diet quality among included food pantry users was low, as reflected by inadequate mean group intake of energy, fruits and vegetables, dairy products, and calcium. Even if the group mean intake was adequate, large percentages of study populations did not meet the recommendations for vitamins A, C, D, and B vitamins, or iron, magnesium, and zinc. The representativeness of the studies varied widely and none of them were nationally representative.

Conclusion The current evidence suggests that the dietary intake of most food pantry users does not meet recommendations. Future research should draw more representative samples and investigate the impact of food pantries on users' diet.

J Acad Nutr Diet. 2017;117:563-576.

SOCIOECONOMIC INEQUALITIES IN HEALTH constitute a major challenge for social and health scientists globally. Even in industrialized countries, both morbidity—for example, from diabetes^{1,2} or cardiovascular disease³—and mortality⁴⁻⁶ follow a socioeconomic gradient and are highest among low-income and socioeconomically deprived individuals.^{4,7,8}

Diet plays a central role in the prevention of most of these diseases.^{9,10} Although a large proportion of Western populations does not meet dietary recommendations suggested

by national health authorities,¹¹⁻¹³ low-income populations are at particular risk for low diet quality.¹⁴⁻¹⁷ They tend to consume less fruits and vegetables (F/V)¹⁷⁻¹⁹ and more fats, sugar and preserves, refined cereals,^{20,21} and nondiet soft drinks.²²

Individuals with lower income are assumed to lack access to healthy foods,²³⁻²⁵ social support,²⁶ and cooking skills^{27,28} more often than individuals with higher income. However, the most important reason for the existing relationship between income and dietary quality may be the fact that higher income simply makes healthy and nutritious food more affordable.^{29,30} Higher dietary quality characterized by higher intake of fresh F/V, whole grains, lean meats, and by lower intake of added fats and sugars, has frequently been shown to have higher energy-adjusted costs than diets that are energy-dense but nutrient-poor.^{31,32}

Despite the understanding of dietary inequalities, knowledge about the diet quality among subgroups of low-income populations is limited, as the poorest and perhaps most vulnerable groups to diet deficiencies are not well represented in national probability samples^{33,34} and are hard to

The Continuing Professional Education (CPE) quiz for this article is available for free to Academy members through the MyCDRGo app (available for iOS and Android devices) and via www.eatrightPRO.org. Simply log in with your Academy of Nutrition and Dietetics or Commission on Dietetic Registration username and password, go to the My Account section of My Academy Toolbar, click the "Access Quiz" link, click "Journal Article Quiz" on the next page, then click the "Additional Journal CPE quizzes" button to view a list of available quizzes. Non-members may take CPE quizzes by sending a request to journal@eatright.org. There is a fee of \$45 per quiz for non-member Journal CPE. CPE quizzes are valid for 1 year after the issue date in which the articles are published.

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reach even in dietary studies targeting low-income populations.³⁵

To specifically assess the nutritional status of economically disadvantaged population groups in industrialized countries, a number of studies have investigated individuals using federal^{36,37} or charitable food assistance programs, such as food banks and food pantries.³⁸ Food pantry users are a group of concern, as they are characterized by a high level of food insecurity,^{39–41} even compared to other low-income groups.^{42–44} Although users of food pantries do not necessarily have a low income, as many food pantries are open to anyone in need, independent of income,^{45,46} the demographic profile of food pantry users tends to mirror characteristics that have been shown to increase the risk of poverty with a major proportion of the clientele being unemployed, earning low wages, or reliant on social assistance.^{47,48} Many food pantry users chronically rely on program's assistance,^{49,50} as opposed to the emergency assistance the food pantries were created for.^{47,51}

There is evidence that food pantry users are not fully represented by samples drawn from federal food assistance programs, such as the Supplemental Nutrition Assistance Program in the United States, as only around 40% to 70% of food pantry users also use federal food assistance programs.^{41,49,52} For this reason, results of a recent systematic review of studies investigating the dietary quality of Americans by Supplemental Nutrition Assistance Program participation status³⁶ cannot be reliably extrapolated to users of charitable food assistance programs.

There is a need for research to critically evaluate and synthesize studies investigating the dietary quality of food pantry users. This research might contribute to a more comprehensive picture of the diet and nutritional needs of this vulnerable, often food-insecure population group. This knowledge may assist managers of food banks and food pantries to prioritize foods most needed. It may also allow for more informed planning of future nutrition interventions to improve the diet of this population group.

This systematic review aims to summarize information with regard to the dietary quality of food pantry users. For this purpose, the review synthesizes findings of studies that investigated the dietary intake of food pantry users compared to national recommendations. A secondary aim was to present information about the diet of food pantry users compared to the general population.

METHODS

This systematic review adheres to the reporting guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement.⁵³ Data on the adequacy of dietary intake of food pantry users were summarized according to defined outcome categories. Methods and inclusion criteria were specified in advance and the review was registered in the International Prospective Register of Systematic Reviews (PROSPERO, registration no. CRD42015024509).

Definitions

The terms *food pantry* and *food bank* were used, while recognizing other terms, such as *food aid programs*, *community food programs*, and *food rescue programs*. In some studies,

only one term was used⁵⁴ or other distinctions were made, hinting that there may not be a defined terminology for organizations using different approaches.⁵¹ When citing results of the included studies, we used the definitions of the study authors.

Food pantries might differ from food banks slightly, as they are often smaller and serve clients directly.⁵¹ In addition to foods received from food banks, food pantries usually collect foods, including perishable groceries, and provide those as bags to take home for clients in need. In contrast, food banks usually receive large quantities of foods from the food industry, manufacturers, and federal or supranational sources—such as the European Union food aid⁵⁵—and distribute these foods to smaller charitable agencies including soup kitchen and food pantries. In some countries, such as the United States, food banks and food pantries are allowed to purchase additional food to supplement the food they received from donors.⁴¹

Food banks and food pantries usually allow people to receive food assistance at least once per month or even weekly.^{45,46}

Study Eligibility Criteria

Cross-sectional studies, longitudinal cohort studies, and intervention studies reporting baseline data in English or German were included if they reported on interventions that regularly provide food as bags to take home alone or in combination with other services, such as assistance with clothing or furniture, free of charge or at minimal fixed costs, and that were undertaken from non-federal charitable food assistance agencies.

Studies were included if they reported on socioeconomically disadvantaged adults 18 years and older living in high-income countries who had used a food bank or food pantry at least once in the previous 12 months. Socioeconomic disadvantage was defined as a criterion defined by charitable food organizations to be eligible for their assistance (eg, an income threshold). High-income countries were defined by the World Bank.⁵⁶ For studies including other participants besides food pantry users, at least 90% of the total sample must have used a food pantry at least once in the previous 12 months or measures must have been reported for food pantry users and nonusers separately.

To be eligible, the study must have reported nutritional intake measured by dietary assessment techniques or biomarkers and assessed the adequacy of dietary intake either by comparing intake of foods and/or nutrients with food-based dietary guidelines or dietary reference values, or by scoring dietary intake using indices, such as the Healthy Eating Index (HEI)⁵⁷ or others.^{58,59}

Studies were excluded if they were conducted outside high-income countries or published before 1980. Given the complexity of the research question and its search criteria, studies were likewise excluded if they focused on children and/or youth programs or reported children's and/or youth outcome measures only. Interventions that provided prepared meals to participants, such as soup kitchens or Meals on Wheels programs, were excluded. Food subsidy programs, including interventions providing food vouchers as well as community garden and community-supported agriculture programs, were likewise excluded because these programs have already been reviewed.^{60,61} Finally, intervention studies providing foods to individuals for a short time (study

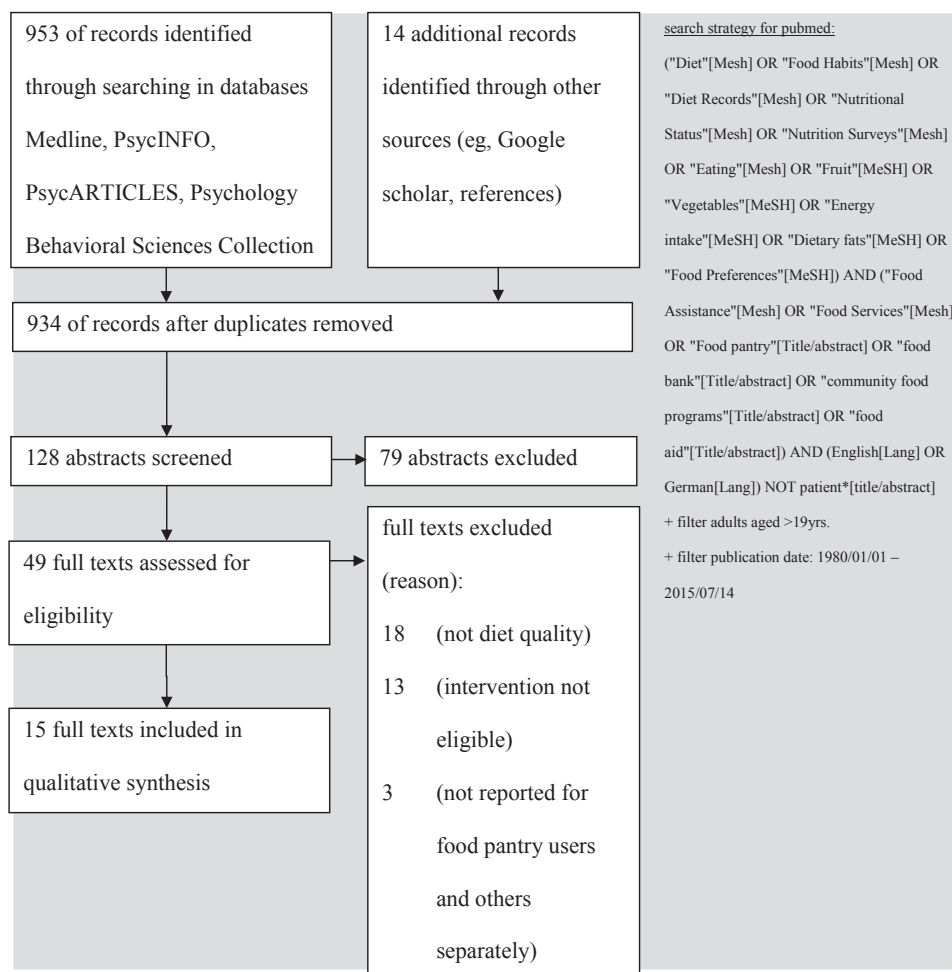


Figure 1. Flow diagram of study selection to identify studies investigating the dietary quality of food pantry users.

duration <6 months) were excluded if they did not report baseline data because the nutritional status of the participants may be influenced by the intervention and might not reflect the average nutritional status of any food pantry user in the long term.

Searching

The electronic databases Medline and EBSCO (PsycINFO, PsycARTICLES, Psychology Behavioral Sciences Collection) and the website Google Scholar were explored using relevant indexing terms. In PubMed, the medical subject heading (MeSH) terms *food supply*, *food services* were combined with the MeSH terms *fruit*, *vegetables*, *energy intake*, *nutrition*, and *diet*, to retrieve studies among food pantries' clients.

Similar search terms were used for the other databases. The last search was conducted on July 14, 2015.

Reference lists of all retrieved articles were reviewed by hand for eligible articles. Specialized websites, including food bank websites, were scanned, and organizations' publications, including annual reports, were reviewed to identify relevant gray literature.

The first author (A.S.) undertook the initial screening of the search results. Studies were rejected if they did not meet the inclusion criteria. Two of the authors (A.S. and J.D.)

independently assessed full texts of studies for eligibility. Disagreements were resolved by discussion, and if no agreement could be reached, the third author (N.S.-B.) made the final decision. If results of a study were not reported for users of food pantries or food banks and nonusers separately, authors were asked to provide raw data or to reanalyze the data. Where data of one study population were reported in more than one article, articles were removed if they did not provide additional information.

Data Extraction and Quality Assessment

A.S. and J.D. independently extracted data using a structured data extraction sheet including study authors, publication year, study design, description of intervention (where applicable), population studied and sample size, description of data collection method, and outcomes. Primary outcome was the dietary intake of food pantry users compared to national recommendations. Four outcome categories, which were not mutually exclusive, were defined: overall dietary quality measured by diet scores such as the HEI, energy intake, food groups, and intake of macro- and micronutrients. Results were summarized according to these categories to evaluate the diet quality. Secondary outcome was the dietary intake of food and nutrient intake of food pantry users compared to

Table. Characteristics of 15 articles^a reporting the dietary quality of food pantry users

Author(s), year, reference	Country	Study design	n	Inclusion criteria	No. of food banks / pantries	Dietary assessment method	Dietary outcome	Comparison of group mean with reference (reference)	Comparison of individual intake with reference (reference)	Comparison with general population
Martin and colleagues, 2013 ⁶⁶	USA	RCT ^b	228	≥ 18 y	2	FFQ ^c (block screener)	F/V ^d	Yes (≥ 16/35 points)	No	Yes
Robaina and Martin, 2013 ⁶⁷	USA	RCT	212	≥ 18 y	2	FFQ (block screener)	F/V+fiber	Yes (≥ 17/50 points)	No	Yes
Miller, 2011 ⁶⁸	USA	Cross- sectional	86	Not declared	3	FFQ	Fr, ^e MD ^f	No	Yes (seldom/ never)	Yes
Holben, 2012 ⁶⁹	Canada	Cross- sectional	528	≥ 18 y	4	"produce-intake" items of the CCHS ^g	F/V	Tes (CFGHE ^h)	No	No
O'Reilly and colleagues, 2012 ⁶³	Australia	Cross- sectional	21	≥ 18 y, asylum seekers	1	24-HDR, ⁱ multiple-pass approach	G, ^j Fr, V, ^k MD, MA ^l	Tes (AGHE ^m)	No	No
Castetbon and colleagues, 2011 ⁶⁵	France	Cross- sectional	396	≥ 18 y	48 aid centers	FFQ	G, F/V, MD, MA	No	Yes (PNNS ⁿ)	Yes
Duffy and colleagues, 2009 ⁷⁰	USA	Cross- sectional	55	19 to 50 y, female	1	24-HDR	G, Fr, V, MD, MA, Na ^o	Tes (HEI ^p)	Yes (HEI)	Yes
Rush and colleagues, 2007 ⁷¹	Canada	Cross- sectional	77	≥ 18 y, Columbian immigrants	1	24-HDR	G, F/V, MD, MA, En ^q	No	Yes (CFGHE)	Yes
Tarasuk, 2001 ⁷²	Canada	Cross- sectional	153	19 to 49 y, female with ≥ 1 child (<15 y)	21	3×24-HDR	G, F/V, MD, MA	Yes (CFGHE)	No	Yes
Jacobs Starkey and Kuhnlein, 2000 ⁶⁴	Canada	Cross- sectional	428	≥ 18 y	20	4×24-HDR	G, F/V, MD, MA	Yes (CFGHE)	Yes (CFGHE)	Yes
Jacobs Starkey and colleagues, 1999 ⁷³	Canada	Cohort study	428	≥ 18 y	20	4×24-HDR	G, F/V, MD, MA, En, P, ^r A, ^s C, ^t Fo, ^u T, ^v Ca, ^w Fe, ^x Mg, ^y Zn ^z	Yes (RNI) ^{aa}	Yes (CFGHE)	Yes
Tarasuk and Beaton, 1999 ⁷⁴	Canada	Cross- sectional	153	19 to 49 y, female with ≥ 1 child (<15 y)	21	3×24-HDR	En, P, A, C, Fo, Ca, Fe, Mg, Zn	Yes (national reference)	Yes (national reference)	No
Bell and colleagues, 1998 ⁷⁵	USA	Cross- sectional	69	Not declared	1	24-HDR	G, F/V, MD, MA, En, P, A, C, D, ^{bb} E, ^{cc} Fo, Ni, ^{dd} Py, ^{ee} Rf, ^{ff} T, Ca, Fe, Mg, Ph, ^{gg} Se, ^{hh} Zn	Yes (RDA) ⁱⁱ (<67 % RDA)	Yes (national reference)	Yes

(continued on next page)

Table. Characteristics of 15 articles^a reporting the dietary quality of food pantry users (*continued*)

Author(s), year, reference	Study Country design	Inclusion n criteria	No. of food banks / pantries	Dietary assessment method	Dietary outcome	Comparison		
						Comparison of group mean with reference (reference)	Comparison of individual intake with reference (reference)	Comparison with general population
Starkey and colleagues, 1998 ⁷⁶	Canada Cross-sectional	490 ≥18 y	20	4×24-HDR ^b	Cb, J, P, F ^{kk}	Yes (national reference)	No	Yes
Lenhart and Read, 1989 ⁷⁷	USA Cross-sectional	20 Not declared	1	24-HDR ^b	En, A, C, Ni, Ri, T, Ca, Fe	No	Yes (RDA)	No

^aArticles reporting data of the same study population: Martin and colleagues (2013)⁶⁶ and Robaina and Martin (2013)⁶⁷; Tarasuk (2001)⁷² and Tarasuk and Beaton (1999)⁷⁴; Jacobs Starkey and colleagues (1999)⁷³ and Starkey and colleagues (1998)⁷⁶.

^bRCT=randomized controlled trial.

^cFFQ=food frequency questionnaire.

^dF/V=fruits and vegetables.

^eFr=fruits.

^fMD=milk and other dairy products.

^gCHS=Canadian Community Health Survey.

^hCFGHE=Canadian Food Guide to Healthy Eating.

ⁱ24-HDR=24 hour dietary recall.

^jG=grain products.

^kV=vegetables.

^lMA=meat and alternatives.

^mAGHE=Australian Guide to Healthy Eating.

ⁿPNNS=Programme National Nutrition Sante.

^oNa=sodium.

^pHEI=Healthy Eating Index.

^qEn=energy.

^rP=protein.

^sA=vitamin A.

^tC=vitamin C.

^uFo=folate.

^vT=thiamin.

^wCa=calcium.

^xFe=iron.

^yMg=magnesium.

^zZn=zinc.

^{aa}RNI=Reference Nutrition Intake (97.5% of the population's requirement is met).

^{bb}D=vitamin D.

^{cc}E=vitamin E.

^{dd}Ni=niacin.

^{ee}Py=pyridoxine.

^{ff}Ri=riboflavin.

^{gg}Ph=phosphorus.

^{hh}Se=selenium.

ⁱⁱRDA=Reference Dietary Allowance (97.5% of the population's requirement is met).

^{jj}C=carbohydrates.

^{kk}F=fat.

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general populations. Where available, the results were extracted separately for men and women and for different age groups. The extracted quantitative data of the primary studies were illustrated by graphs by using a spreadsheet program (Excel 2007, Microsoft Corporation).

Due to the heterogeneity of study designs and diet measures, summaries consist primarily of qualitative information.

Two authors (A.S. and J.D.) evaluated the included studies for risk of bias using criteria (selection and outcome assessment) of the Newcastle-Ottawa scale⁶² adapted for cross-sectional studies.

RESULTS

The systematic literature search identified 967 citations, of which 15 full texts (including 11 studies) fulfilled the inclusion criteria. The two raters (A.S. and J.D.) were uncertain about the eligibility of two articles.^{63,64} Both articles were included after consultation with the third author (N.S.-B.). Authors of three articles were contacted to request data for users of food banks or food pantries separately from data of other participants. This led to the inclusion of one more study.⁶⁵ The detailed study selection process is shown in Figure 1.

Characteristics of Included Studies

Characteristics of the studies are shown in the Table. Of the 11 studies, nine were cross-sectional in design,^{63,65,68-72,75,77} one was a randomized controlled trial reporting baseline data,^{66,67} and one was a cohort study over 4 consecutive weeks.⁷³ Sample sizes ranged from around 20 to 50 food pantry users^{63,70,77} to around 500 to 550 users.^{65,69,73} Sample sizes of investigated food banks or food pantries ranged from 1 to 4^{63,66-71,75,77} to around 20 food banks or food pantries.^{64,72-74,76} Five studies were conducted in the United States,^{66-68,70,75,77} four in Canada,^{64,69,71-74,76} one in Australia,⁶³ and one in France.⁶⁵ The dietary tool used most often was a single 24-hour dietary recall.^{63,70,71,75,77} One study used three 24-hour dietary recalls,^{72,74} and one study used four recalls^{64,73,76} over 3 and 4 consecutive weeks, respectively. Three studies collected dietary data via food frequency questionnaires⁶⁵⁻⁶⁸ and one study used questions on produce intake only.⁶⁹ Adequate dietary intake was mostly estimated by comparing mean group intake (further on: mean intake) with dietary recommendations^{63,64,66,67,69,72,73,75,76} or by comparing individual dietary data with dietary recommendations.^{64,65,68,71,73,75,77} One study applied the probability approach as described by the US National Research Council⁷⁸ to estimate the prevalence of inadequate intake in the study population.⁷⁴ References used to assess adequacy included national guides, such as the Canadian Food Guide to Healthy Eating^{63-65,69,71-73,76} or maximum scores on a block screener for food intake^{66,67} and the Reference Dietary Allowance, Reference Nutrient Intake, or nutrient adequacy ratios based on the Reference Dietary Allowance for nutrient intake.^{64-69,71,73} In one study, individual and mean scores of the HEI and its subcomponents were calculated to assess dietary adequacy.⁷⁰ Six articles reporting on four studies compared the dietary intake or the diet quality between food pantry users and the general population (Table).^{64,65,72,73,75,76}

The total number of participants was 6,048 individuals. Two studies included females only,^{70,72} one Australian study

included asylum seekers only,⁶³ and one Canadian study included Colombian immigrants only (Table).⁷¹

The total number of studied food banks and food pantries was 55. In one study, the exact number of food pantries is unknown because only the total number of studied food aid centers (n=48), including food pantries, social groceries, and meal programs, was available.⁶⁵

Examined dietary outcomes varied with nine articles (of eight studies) reporting adequacy of intake of diverse food groups^{63-65,68,70-73,75} and three articles (of two studies) presenting intake of F/V only.^{66,67,69} Total energy intake was assessed in five studies.^{71,73-75,77} Seven articles (of six studies) evaluated intake of 1⁷⁰ up to 18 nutrients including mostly macronutrients, calcium, iron, and vitamins A and C (Table).^{71,73-75,77}

Risk of Bias of Included Studies

The representativeness of the data varied widely between studies. None of them were nationally representative of users of food pantries and only two studies were rated to be representative of food pantry users within a geographic area or community.^{64,65,73,76} Three studies appeared to be somewhat representative of food pantry users within the area where the food pantries were located^{72,74} or users of single food pantries,^{66,67,69} because they improved the representativeness by visiting the food pantry on different weekdays and at different times of the day. However, six diet-quality studies were based on convenience samples only.^{63,68,70,71,75,77} All studies except one⁶⁵ used validated instruments to assess diet, but all of them relied on self-report of participants. The evaluation of the risk of bias, including the used criteria, is available on request from the corresponding author. There was no disagreement between the two raters.

RESULTS OF INCLUDED STUDIES

Study Populations

Study populations were generally characterized by low income,^{66-68,70,72,74,76,77} receiving social welfare benefits,^{65,71-74,76} unemployment,^{65-67,74,76} middle age (mean=33 to 51 years; range=18 to 84 years),^{63,65-73,75,77} having a place to live,^{65,74,75} and often belonging to ethnic minorities.^{63,65-67,69-71,73,74,76} In most studies, the majority of participants were single^{65-69,73} and female,^{65-72,74,75,77} and large percentages of participants were single parents.^{65,70,72,74} In studies reporting respective data, the majority of participants had an income below national poverty cutoffs^{68,70,74} and lived in food-insecure households.⁶⁶⁻⁷² Depending on the used cutoff (body mass index ≥ 25 or ≥ 28) around 30% of participants^{73,76} to 90% of participants were overweight or obese.^{66,67,70,74,75}

Food Banks and Food Pantries

Four studies investigated users of traditional food banks or food pantries where clients usually receive a predefined bag of food.^{64,65,72-74,76,77} The randomized controlled trial also reported baseline data of users of traditional food pantries (the intervention was a choice pantry model).^{66,67} The study investigating the dietary quality of asylum seekers was conducted in a supermarket-style food bank in which every food item was associated with a point value and every client received a total amount of points depending on the family

size.⁶³ Five studies provided no precise description of the program scheme.^{68-71,75}

Information about the frequency of food bank or pantry use varied widely. Only one study investigated the relationship between frequency of food bank use and dietary outcomes and found a negative association for intake of folate, protein, vitamin C, calcium, magnesium, and zinc.⁷³ In one study, the mean number of times participants had received assistance from a food bank was 13±11 times over the previous 12 months.^{40,72,74} The authors of the randomized controlled trial reported that 63% of participants visited a food pantry at least once per week.^{66,67} In the supermarket-style food bank in Australia, clients were allowed to shop on a weekly basis and for all participants the food bank was the main source of food.⁶³ In a French study, food aid centers (including food pantries, meal programs, and grocery stores) were also the main source of food for all food items except for bread.⁶⁵ For the other studies, information about the individual frequency of food pantry use was not available.^{68-71,75,77}

Overall Diet Quality

Only one study assessed the overall diet quality by using the HEI.⁷⁰ Scores <50 indicate a diet that is not health-promoting and the 48 female food pantry users had a mean score of 42.8 out of 100; none of the women scored >80 and only 29% of the women scored >50.⁷⁰

Energy

For those studies with adequate data (n=5), mean energy intake separated by sex are shown in Figure 2, along with

recommendations of the Food and Agriculture Organization of the United Nations for energy intake given a moderate activity level (mean physical activity level of 1.75) and an assumed body weight of 60 kg and 80 kg for women and men, respectively.⁷⁹ In both sexes and across all studied age groups, mean group energy intake was less than recommended,^{71,73,74,77} except among men in a small US sample.⁷⁵

Food Groups

Comparison of group mean intake with recommendations is shown in Figure 3. As shown in Figure 3, in all articles except one,⁷³ reported mean intake of F/V was below the recommended number of servings per day.^{63,64,66,67,70-72} Jacobs Starkey and colleagues⁷³ reported that the mean intake of F/V was above the recommended number of servings in the study sample, but when separating sex and age groups, the mean intake was below the recommendations in women aged 18 to 49 years.⁶⁴

When looking at the prevalence of inadequate F/V intake as shown in Figure 4, the majority of participants consumed fewer than the recommended five^{71,73} or seven servings of F/V per day.⁶⁹ Even when less strict cutoffs were used, around 34%⁶⁵ to 54% of participants^{66,68} showed inadequate F/V intake. The study calculating individual subscores of the HEI found nearly 70% of 48 female food pantry users reporting no consumption of fruits and 25% of the women reported no consumption of vegetables.⁷⁰

Similar tendencies were observed for milk products (Figures 3 and 4). Irrespective of the used cutoff to define adequate intake, none of the studies found adequate mean

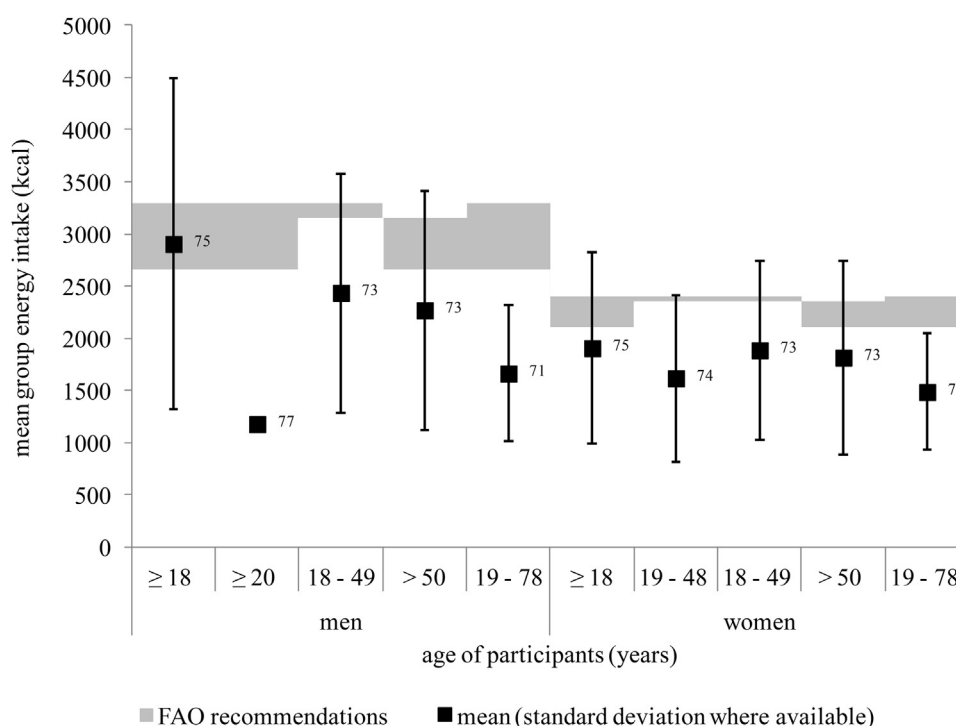


Figure 2. Mean energy intake of food pantry users reported in five research articles. Note: each box represents an average intake from the reviewed literature; the vertical lines represent standard deviations, where available; the gray space represents the recommendations from the Food and Agriculture Organization of the United States (FAO); numbers are reference citations. Lenhart and Read⁷⁷ did not report data for men (n=8) and women (n=12) separately; Tarasuk and Beaton⁷⁴ included women only.

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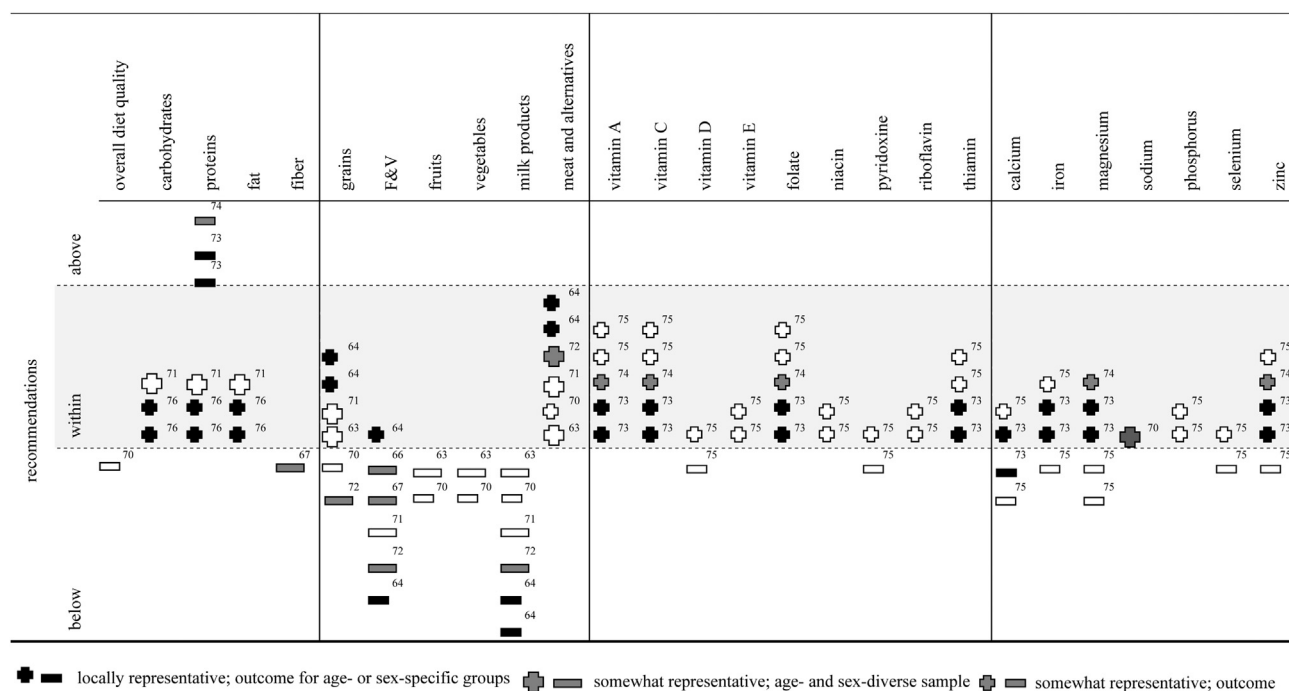


Figure 3. Adequacy of mean group dietary intake among food pantry users reported in 11 research articles. Note: plus and minus indicate a mean group intake above and below national recommendations.

intake of milk products (Figure 3).^{63,64,70-72} The percentage of participants with inadequate intake ranged between around 35%^{65,68} to >70% of participants (Figure 4).^{73,75}

Larger variations between study samples were found for grains. Two Canadian studies using the Canadian Food Guide to Healthy Eating as a cutoff to define adequate intake found that the mean intake of grains was above the recommended five servings of grains per day among the participants (Figure 3).^{64,71} The Australian study also reported that the

mean intake of grains was above the recommended four servings per day as described in the Australian Food Guide to Healthy Eating.⁶³ Tarasuk (also using the Canadian Food Guide),⁷² and Duffy and colleagues (using the HEI)⁷⁰ found the mean intake of grains to be inadequate in the study population. Even when the mean intake of grains was considered adequate, a substantial percentage of the participants were found to have an intake of grains below the recommended number of servings (Figure 4).^{64,71}

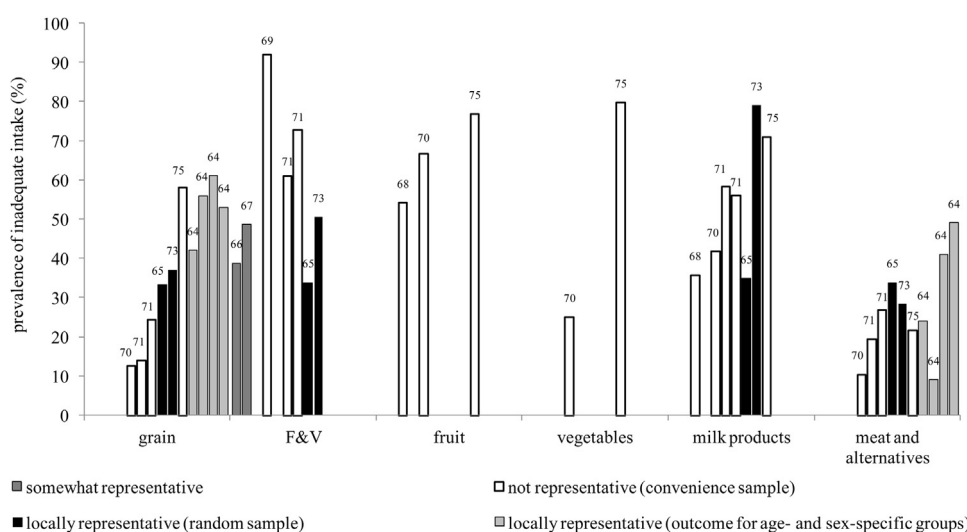


Figure 4. Prevalence of inadequate intake of food groups among food pantry users reported in 10 research articles. Note: each column represents the prevalence of inadequate intake reported in the reviewed literature; numbers represent reference citations; Rush and colleagues⁷¹ reported data for men and women separately; Starkey and colleagues⁶⁴ reported data for men and women aged 18 to 49 years and above 50 years separately.

All five studies comparing the mean intake of meat and alternatives with recommendations found the mean intake to be adequate (Figure 3).^{63,64,70-72} Furthermore, six articles, including three^{64,70,71} of the five studies^{63,64,70-72} reporting that the mean intake of meat and alternatives was adequate, found that between around 10%⁷⁰ and 40% of participants^{64,65,71,73,75} had an inadequate intake of meat and alternatives (Figure 4).

Macronutrients and Micronutrients

Intake of macronutrients expressed as percentage of total energy intake met recommendations in two studies (Figure 3).^{71,76} In another two studies, mean group protein intake was clearly above recommendations, but large variations within the study populations were evident.^{73,74} For instance, Tarasuk and Beaton⁷⁴ found that the mean intake of protein was above the reference value, but 15% of the female participants had an intake below recommendations (Figure 5).

Mean intake of vitamins A and C was within recommendations in all three studies reporting mean intake of these vitamins (Figure 3).⁷³⁻⁷⁵ Variations between study participants were large, however, and despite an adequate mean intake, Bell and colleagues⁷⁵ found that 33% to 57% of men and women had an intake of vitamins A and C below the reference intake (Figure 5). Although Lenhart and Read⁷⁷ used a stricter reference value, they even reported that 75% and 55% of the 191 participants had an inadequate intake of vitamins A and C, respectively. Finally, the study using the probability approach found around 28% and 3% of the 153 female participants had an intake of vitamins A and C below the mean requirement estimates (Figure 5).⁷⁴

Concerning vitamins D and E, Bell and colleagues⁷⁵ found adequate mean intake in men, but mean intake of vitamin D was inadequate in women (Figure 3).

Three studies found adequate mean intake of folate⁷³⁻⁷⁵ and two studies found adequate mean intake of thiamin in

their study samples.^{73,75} Bell and colleagues⁷⁵ found that the mean intake of niacin and riboflavin was adequate in both sexes, and the mean intake of pyridoxine was adequate in men only. As shown in Figure 5, prevalence of inadequacy for these nutrients varied widely between studies. Although using a stricter cutoff, Lenhart and Read⁷⁷ found higher prevalence rates for all of these nutrients than Bell and colleagues,⁷⁵ as well as Tarasuk.⁷²

Among minerals, mean calcium intake was found to be inadequate in women in two studies (Figure 3).^{73,75} Similarly, Bell and colleagues found inadequate mean intakes of iron, magnesium, selenium, and zinc in women.⁷⁵ Again, prevalence rates of inadequacy for minerals varied widely between studies (Figure 5).^{74,75,77} All rates were higher in women than in men except for calcium.⁷⁵

Comparison of Dietary Intake and Diet Quality with the General Population

Castetbon and colleagues⁶⁵ found that the prevalence of inadequate intake of F/V and milk products was higher in their study sample than in the general French population, and the intake of seafood was similar to that of the general population.

Tarasuk⁷² revealed that the mean intake of milk products was lower in her sample of food pantry users compared to the general Canadian population, while Jacobs Starkey and Kuhnlein⁶⁴ reported that the percentage of food bank users meeting the recommendations was also lower for milk products, but higher for F/V and meat and alternatives than in the general Quebec population. Based on the same study population, Starkey and colleagues⁷³ revealed that the energy intake of the included food bank users was similar to that of the general Quebec population, except for men aged 19 to 49 years, whose mean energy intake was higher in the general population compared to the study participants.

On the other hand, Bell and colleagues⁷⁵ concluded that a sample of 69 food bank users consumed a poorer diet than

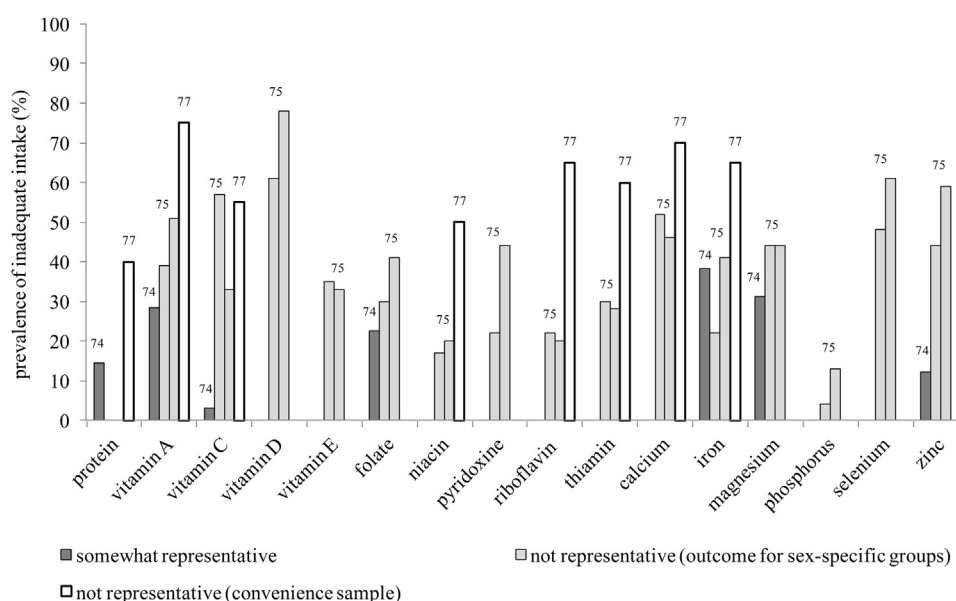


Figure 5. Prevalence of inadequate intake of nutrients reported in three research articles. Note: each column represents the prevalence of inadequate intake reported in the reviewed literature; numbers are reference citations; Bell and colleagues reported data for men and women separately.⁷⁵

the general US population, consuming fewer F/V and more high-fat meats.

DISCUSSION

This review has systematically synthesized 15 articles of 11 studies investigating the dietary quality of food bank and pantry users.

Large variations were found between studies. However, all studies found mean intake of F/V and dairy products to be below recommendations and mean intake of meat and alternatives to be within recommendations, except one study,⁷³ which reported that the mean intake of F/V was within recommendations. A lower percentage of food pantry users met the recommendations for F/V and milk than in the respective general population. For intake of grains, results were more heterogeneous. Depending on used cutoffs, all studies, even those that found the mean intake was adequate, reported that around 13% to >50% of participants had an inadequate intake.

Reflecting the low mean intake of milk products, the mean intake of calcium was below the reference intake, especially in women.

Despite the inadequate mean intake of F/V found, vitamins A and C were, on average, above the reference value among included food pantry users. Unfortunately, only one study reported the mean intake of both F/V and vitamins A and C. We are, therefore, not able to explain whether the divergent results can be explained by different data collection methods used between the studies or are based on existing differences in dietary intake between the study samples—for example, a diet rich in vitamins A and C from sources other than F/V.

In addition to vitamins A and C, all studies reported that the mean intake of micronutrients was within the reference intake for vitamin E, folate, niacin, riboflavin, thiamin, sodium, and phosphorus. However, this was not the case for the mean intake of vitamin D, pyridoxine, iron, magnesium, selenium, and zinc in women, which was lower than the recommendations.

Large variations in dietary intake were also found within study populations with the result that even in those samples in which mean intake of nutrients was above recommendations, significant percentages of the study populations had an intake below the recommendations.

The observed variations between the studies likely stem from the diversity in methods used and dietary reference values chosen. A comprehensive review of European studies, for instance, found that around 25% or 75% of the female population had an inadequate intake of folate, depending on the applied reference value.⁸⁰

In addition, the 24-hour dietary recalls in most studies had been conducted on the day the participants visited the food pantry, which likely influenced the quantity and quality of the food they had consumed the previous day.

Heterogeneous methods, as applied in the included studies, do not necessarily limit the significance of results. Although different methods were applied, the evaluation of the intake of food groups appears to be consistent across studies.

In the long term, inadequacies in nutrient intake are related to the development of major health problems. For instance, vitamin A deficiency can result in several health complications, including xerophthalmia, impaired immune system functions, and poor growth.⁸¹ Deficiencies in other

nutrients can likewise lead to poor health conditions, underlying the importance of regular intake. Food pantries and food banks could be a source of supply for these nutrients. However, it seems that individuals who were most reliant on food banks fared least well with regard to micronutrient intake. In the study by Jacobs Starkey and colleagues,⁷³ among 490 food banks users, the frequency of food bank use was negatively associated with nutrient intake when controlling for other individual and social variables. In addition to the frequency of food bank use, the scheme of the food bank or food pantry—for instance, whether the clients are allowed to choose foods based on needs and preferences or whether they receive a predetermined bag—likely has a substantial impact on the dietary quality of users. The reviewed studies examined different food bank schemes, but some of them provided little information about the operating practices. Therefore, this systematic review is not able to compare the dietary quality of users of food banks or pantries comparing different food distribution schemes. However, the randomized controlled trial investigating the effect of a client-choice pantry model and individualized case management, including monthly motivational interviews and targeted referrals to other services, showed that during 1 year, intervention participants were less than half as likely to live in households with very low food security, increased self-sufficiency, and F/V consumption by one serving per day compared to the control group.^{66,67} Other food pantries and food banks have also implemented a choice-based model⁸² or applied nutrition profiling.^{83–85} These are promising approaches, however, very few empirical studies have investigated the impact of these initiatives on individual diet,^{66,86} and none studied the impact on overall dietary quality.

The consumption of F/V, for instance, appeared to be a particular concern among food pantry users. As revealed by qualitative research, many food pantry users stated that they would like to receive more fresh F/V.^{87–89} Given the high energy-adjusted costs of F/V, which was reported as an important barrier for its consumption in low-income populations,^{90–92} the supply of more F/V for free or at minimal costs at food pantries may have a positive impact on its intake in food pantry users.

Although intake of meat and alternatives was adequate in most pantry populations included in this review, qualitative research also revealed that pantry users frequently desire to receive more meat^{87,89,93} and perceive their meat intake as less than acceptable.⁸⁸ Although qualitative studies did not assess current meat intake of participants, it is likely that participants may be misinformed about the recommendations for meat intake. Food pantry users may therefore benefit from nutrition education.⁸⁶

Given that, for example, Greger and colleagues⁹³ revealed that less than half of the 252 surveyed food pantry users knew how to prepare all the food they have received from the pantry, cooking classes^{94,95} and the provision of recipes⁸⁶ may be potential measures to improve the diet of food pantry users. A recent study found, for instance, that a cooking and nutrition education intervention at four food pantries increased overall diet measured by the HEI and improved cooking skills among the participants.⁹⁴ One study investigating the impact of a food bank intervention (a 6-week cooking class) on body weight found that the mean body mass index significantly decreased during the 6 months of follow-up.⁹⁵

The need to conduct more empirical studies investigating the impact of different operating procedures and additional services of food pantries and food banks on overall dietary quality and body weight seems high, given that many reviewed studies reported a high percentage of participants to be overweight or obese, despite their high rates of food insecurity.

The food insecurity-obesity paradox is not yet fully understood and there is some controversial debate about whether participation in any federal food assistance program, such as the food stamps program, may be related to a higher body mass index.^{96,97} This review is not able to contribute knowledge about the relationship between obesity and participation in charitable food assistance programs, but within the included food pantry populations, food insecurity was related to the tendency of a less healthy diet while controlling for other variables, such as household income and educational level.^{67,74}

Limitations

This systematic review is limited to studies and information provided in English and German and the heterogeneity of the studies did not allow for statistical analysis to draw a more valid conclusion about the diet quality of food bank and food pantry users.

Furthermore, the systematic search did not identify any studies that were representative for national populations or for all food pantries within a country, which limits the generalizability of the results.

In addition, the included studies used diverse dietary assessment methods, which all relied on individuals' self-reports only. While it has been widely recognized that reported dietary intake differs considerably by applied assessment method,^{98,99} for low-income populations four multiple-pass 24-hour recalls have been assumed to be the most appropriate method for the evaluation of nutritional adequacy.³³ However, only two studies used repeated 24-hour recalls^{64,72-74,76} and only a few controlled the results for underreporting.^{73,74}

Finally, a very broad criterion was used to define eligible participants, as they must have used a food bank or food pantry only once (minimum) in the previous 12 months. Whether a participant uses a food bank or food pantry once a year, every month, or even weekly, is likely to have a substantial impact on the dietary quality of the participant, but this systematic review is not able to provide a deeper understanding of this relationship, and results of the primary studies do not necessarily reflect the dietary quality of a regular user of a food pantry.

CONCLUSIONS

The current evidence suggests that the dietary quality of studied food pantry users is inadequate, particularly for F/V, milk products, and calcium. Many food pantry users appear to have an inadequate energy intake; a finding that urgently needs additional research, given that a large percentage of the included participants were overweight or obese. This systematic review identifies three open research questions that future studies need to address. Firstly, this systematic review included cross-sectional data only and it became clear that very few longitudinal studies have been conducted so

far. Future studies investigating the impact of food pantries on individual dietary quality by applying well-planned longitudinal study designs are needed. Secondly, in addition to dietary quality, future studies should investigate the impact of the assistance of food pantries on individual body weight. Thirdly, future research should compare the dietary quality of users of traditional food pantries providing predefined bags of food and users of choice-based food pantries or pantries implementing nutrition-based policies, such as a "no soda, no candy" donation policy or any other initiative to identify best practice examples. An open-access database of such examples could include guidance to other food pantry programs on how to implement these nutrition-based initiatives.

Food pantries are recommended to broaden their mandate beyond distributing as much food as possible by addressing the multifaceted causes of food insecurity and malnutrition. By distributing more F/V and milk products, they have the potential to improve the users' intake of these food groups. Certainly, this requires substantial personnel and financial capacities. Securing that all people have enough food must be a political task rather than one of charitable organizations and food pantries. Given the direct provision of food to people in need, the institutionalized net of food banks and food pantries has, however, an immense potential to improve the dietary quality of vulnerable population group when focusing on perishable, nutritious foods and providing educational and/or practical interventions.

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For more information on the subject discussed in this article, see the Sites in Review in this month's New in Review section.

AUTHOR INFORMATION

A. Simmet is a PhD student, J. Depa is a PhD student and research associate, and N. Stroebele-Benschop is a full professor, Institute of Clinical Nutrition, University of Hohenheim, Stuttgart, Germany. P. Tinnemann is head of the Global Health Science Unit, Institute for Social Medicine, Epidemiology, and Health Economics at the Charité-Universitätsmedizin Berlin, Berlin, Germany.

Address correspondence to: Anja Simmet, Dipl.-Ges.oec., Institute of Clinical Nutrition, University of Hohenheim, Fruwirthstr 12, 70599 Stuttgart, Germany. E-mail: Anja.Simmet@uni-hohenheim.de

STATEMENT OF POTENTIAL CONFLICT OF INTEREST

No potential conflict of interest was reported by the authors.

FUNDING/SUPPORT

There is no funding to disclose.

PROSPERO Reg. No. CRD42015024509.

ACKNOWLEDGEMENTS

The authors would like to acknowledge Katia Castetbon, PhD, for providing results of the ABENA study for food bank users and users of soup kitchens separately.

Chapter 3

The nutritional quality of food provided from food pantries: a systematic review of existing literature

Simmet A, Depa J, Tinnemann P, Stroebele-Benschop N.

J Acad Nutr Diet. 2017;117(4):577-588. doi:10.1016/j.jand.2016.08.015



The Nutritional Quality of Food Provided from Food Pantries: A Systematic Review of Existing Literature

Anja Simmet, Dipl.-Ges.oec.*; Julia Depa, MSc; Peter Tinnemann, MD, MPH; Nanette Stroebele-Benschop, PhD

ARTICLE INFORMATION

Article history:

Submitted 4 April 2016
Accepted 18 August 2016
Available online 7 October 2016

Keywords:

Food insecurity
Food banks
Charitable food assistance
Food supply
Poverty

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<http://dx.doi.org/10.1016/j.jand.2016.08.015>

*Dipl.-Ges.oec. is a German degree comparable with the international MSC.

ABSTRACT

Background In many affluent countries, food-insecure households use food pantries to keep their family fed. The long-term dependence of many users on these programs calls for a systematic review of studies on the nutritional quality of food provided by food pantries.

Objective The purpose of this systematic review was to summarize the current scientific evidence about the nutritional quality of food bags distributed by food pantries.

Methods A systematic literature search was conducted in the electronic databases PubMed, PsycINFO, PsycARTICLES, and Psychology Behavioral Sciences Collection to identify cross-sectional, cohort, and intervention studies reporting baseline data conducted in high-income countries and published between 1980 and 2015, which reported the nutritional quality of food bags distributed by food pantries. Identified citations were screened in two stages and data were independently extracted by two authors using a predefined data sheet. The quality of included studies was evaluated using criteria of an adapted Ottawa Scale. The systematic review was reported in accordance to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement.

Results Applying the two-stage screening, 9 of 1,546 articles were identified for inclusion. Nutritional quality of food bags varied widely between and within studies. Milk products, vitamins A and C, and calcium were provided in particularly low amounts. None of the studies were nationally representative and only a few studies controlled for the household composition of the recipients of food bags.

Conclusion Food pantries likely have a strong influence on users' diets, but the food pantries examined in the selected studies were largely unable to support healthy diets. The distribution of more perishable foods would increase users' diet quality and may have an immense potential to address malnutrition in vulnerable population groups.

J Acad Nutr Diet. 2017;117:577-588.

IN MANY AFFLUENT COUNTRIES, THE PREVALENCE OF food insecurity has increased in recent years.¹⁻³ Food insecurity exists whenever the availability of nutritionally adequate and safe foods or the ability to acquire acceptable foods in socially acceptable ways is limited or uncertain.⁴

Food insecurity tends to be higher in households relying on social assistance, in households of single parents, and in

ethnic minorities.^{1,3} Many food-insecure households use various coping strategies, including prioritizing food quantity over quality, "stretching" food, and finding sources of free food, such as food banks and food pantries.^{5,6} Food-insecure households are much more likely to use a food pantry than food-secure households.⁷⁻⁹

Traditional food pantry programs supply eligible households with predetermined bags of nonprepared food items donated by retailers, manufacturers, industries, producers, churches, and community members, which are intended to last a certain number of days, usually 3 to 5 days.^{10,11} Recently, some food pantries have adopted a choice model where clients can shop in a grocery store-like atmosphere and choose food based on needs, preferences, and household size.^{12,13} Although food pantries have initially been established as temporary food assistance, many users chronically rely on food pantry assistance.^{14,15} The number of clients of most food pantries has increased steadily,^{16,17} and over the last several decades food pantries have become a fixed part of

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food landscapes in countries such as the United States,¹⁶ Canada,¹⁷ Australia,¹⁸ and several European countries.^{19–22}

While food pantries usually allow people to receive their food assistance at least once per month or even weekly,^{23,24} many users are reported to use the food pantry whenever possible.¹⁴

Long-term dependence on food pantries, in combination with the unpredictable nature of donated foods, calls for a comprehensive evaluation of the literature to summarize studies investigating the nutritional quality of food bags provided by food pantries.

This knowledge might contribute to a better understanding of the potential impacts and limitations of food pantries and may help managers of food banks and pantries identify nutritional gaps in their food supply. Finally, it may inform welfare case workers, social agencies, and other providers that often refer people to food pantries and food banks.¹⁰

This systematic review aims to summarize information with regard to the nutritional quality of food bags provided by food pantries in high-income countries. For this purpose, the review synthesizes findings of studies comparing the nutritive value of food provided by the studied pantries compared to national recommendations.

METHODS

The systematic review adheres to the reporting guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement.²⁵ Data on the nutritional quality of food bags that were distributed by food pantries were summarized according to defined outcome categories. Methods and inclusion criteria were specified in advance and the review was registered in the International Prospective Register of Systematic Reviews (PROSPERO, registration no. CRD42015024509).

Definitions

Food aid programs, community food programs, and food rescue programs are just a few of the diverse terms used to denote programs that provide charitable food assistance. Throughout this article, the terms *food banks* and *food pantries* are used according to the definitions presented here. When citing results of the included studies, the definitions of the study authors were used.

Food banks usually receive large quantities of foods from industry, manufacturers, and federal or supranational sources, such as The Emergency Food Assistance Program²⁶ or the European Union Food Aid,²⁷ and distribute these foods to smaller charitable agencies, including soup kitchens and food pantries.

Food pantries tend to be smaller than food banks and serve clients directly.²⁸ In addition to foods received from food banks, food pantries usually collect foods, including perishable food items, and provide those in bags for clients to take home.¹⁶

Study Eligibility Criteria

To be included in this systematic review, articles had to describe a cross-sectional, cohort, or intervention study reporting baseline data. In addition, included studies had to report on activities that regularly provide food in bags to take home alone or in combination with other food-related

services, such as assistance related to government programs or nonfood services, such as assistance with clothes. The distribution of food bags had to be free of charge or at minimal fixed costs and had to be undertaken by nonfederal charitable food assistance agencies and conducted in high-income countries. World Bank definitions were used to categorize high-income countries.²⁹

Furthermore, the article must have provided original data on the nutritional quality of the supplied food bags by comparing the dietary content with dietary recommendations and had to be published in English or German.

Although there are common features of food banks operating in low-, middle-, and high-income countries, food bank programs in low-, and middle-income countries differ from food banks in high-income countries in several measures. For instance, food banks in Uganda provide seeds and practical training in farmer methods and agribusiness to farmers directly,³⁰ whereas food banks in high-income countries sometimes cooperate with local farmers and farmers' cooperatives to expand their range of donors, but they do not usually teach them.¹⁶ Due to the complexity of these differences, studies conducted outside high-income countries were excluded. Due to differences in operations, aims, and eligibility criteria between usual food pantries and food pantries for children only, articles were excluded from formal review if they focused on children and/or youth programs only. They were also excluded if they reported on beverage and food inventory of food banks or food pantries only, because the inventory data may not necessarily reflect the amount and quality of food provided to any single user. Articles were likewise excluded if they reported on interventions that provided prepared meals to participants, such as soup kitchens or Meals on Wheels programs; on food subsidy programs, including interventions providing food vouchers; or on community garden and community-supported agriculture programs. Finally, intervention studies providing foods to individuals for a short time (study duration <6 months) were excluded. These interventions may be promising approaches to improve the nutritional quality of provided food, but they may not reflect the "usual" food supply of food pantries in the long term.

Searching

A systematic literature search was performed in the electronic database Medline using the medical subject headings (MeSH) *food supply*, *food services*, *food assistance*, and *nutritive value*, *food quality*, and free-text keywords such as *food bank*, *food pantry*, and *community food assistance* (Figure 1). In the electronic databases PsycINFO, PsycARTICLES, and Psychology Behavioral Sciences Collection, combined free-text keywords were used. The last search was conducted on July 14, 2015.

In addition, reference lists of all included articles were screened by hand for potentially eligible articles. Specialized websites, including food bank website, were scanned and organization's publications including annual reports were reviewed to identify relevant gray literature.

All citations were screened in two stages. The initial screening (conducted by author A.S.) was based on titles, abstracts, and keywords. Full-text versions of the citations were obtained if there was doubt regarding eligibility. At the second stage, full texts were independently assessed for

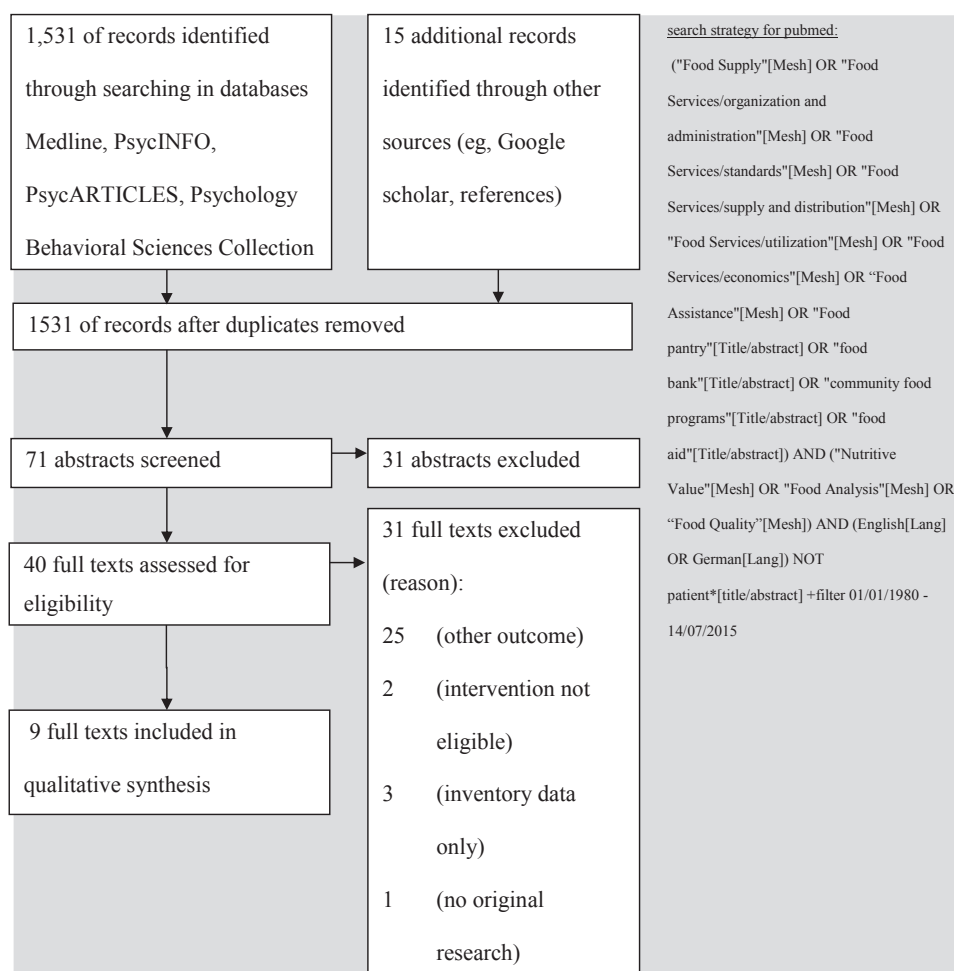


Figure 1. Flow diagram of study selection to identify studies investigating the nutritional quality of food provided from pantries.

eligibility by two authors (A.S. and J.D.). Differences between the authors' assessments were resolved by discussion and, when necessary, in consultation with a third author (N.S.-B.). In cases where multiple articles reported on the same food assistance program, articles were included if they reported different results.

Data Extraction and Quality Assessment

The data extraction was independently performed by two authors (A.S. and J.D.) using an *a priori* data extraction form. Extracted data included study authors, publication year, study design, description of intervention, sample size and sizes of food bags, description of data collection method, and references used for the evaluation of the nutritional quality of foods provided, as well as outcomes. Primary outcome was the nutritional quality of food bags supplied by food banks and/or pantries with the following outcome categories: overall nutritional quality, energy, food groups, and nutrients. Nutritional quality was defined as the amount and type of food and nutrients compared to (national) recommendations.

To illustrate the extracted quantitative results of the primary studies, graphs were created by using a spreadsheet program (Excel 2007, Microsoft Corporation).

Due to the heterogeneity of study designs and outcome assessment measures, summaries consist primarily of qualitative information.

Included studies were independently evaluated for risk of bias by two authors (A.S. and J.D.) using three criteria (selection, comparability, and outcome) of the Newcastle-Ottawa scale³¹ adapted for cross-sectional studies.

RESULTS

The systematic literature search in databases yielded 1,431 citations, of which 7 fulfilled the inclusion criteria. An additional 15 studies were identified by articles' references lists or website hand-searches, of which two fulfilled the inclusion criteria. The detailed study selection process is illustrated in Figure 1.

Characteristics of Included Studies

Of the nine studies, eight were cross-sectional in design³²⁻³⁹ and one study was based on data from 3 nonconsecutive years (Table).⁴⁰

Five studies were conducted in Canada,^{33,34,37,38,40} and two of them investigated the same food pantry at different time points^{34,40}; three were conducted in the United States,^{35,36,39}

Table. Characteristics of nine articles reporting the nutritional quality of food bags provided from food pantries

Author(s), year, reference	Country	Study design	No. of food bags	No. of food banks/ pantries	Investigated bag sizes (separate results)	Intended no. of days	Perishable items available	Nutritive outcome	Comparison of group mean with reference (reference)	Percentage of bags with inadequate supply (reference)	No. of days of adequate provision (reference)
Jessri and colleagues, 2014 ⁴⁰	Canada	Time series	1,025	1	1-5 (yes)	4	Yes	G, ^a F/V, ^b MD, ^c MA, ^d En, ^e Cb, ^f Pr, ^g Fa, ^h Fi, ⁱ A, ^j C, ^k Ca, ^l Fe, ^m Zn ⁿ	Yes (CFGHE, ^o RNI ^p)	No	No
O'Reilly and colleagues, 2012 ³²	Australia	Cross- sectional	21	1	Not declared (no)	6.8±0.5	Not declared	G, F, ^q V, ^r MD, MA	Yes (AGHE ^s)	No	No
Inwin and colleagues, 2007 ³³	Canada	Cross- sectional	180	1	1-6 (no ^t)	3	Yes, but not included in analyses	G, F/V, MD, MA, En, Cb, Pr, Fa, A, B-12, ^u C, D, ^v Ni, ^w Ri, ^x T, ^y Ca, Fe, Mg, ^z Zn	Yes (CFGHE, DRI ^{aa})	Yes (DRI)	Yes (CFGHE, DRI)
Willows and Au, 2006 ³⁴	Canada	Cross- sectional	4	1	1; 2 (yes)	4	Yes	G, F/V, MD, MA, En, Fa	Yes (CFGHE)	No	No
Akobundo and colleagues, 2004 ³⁵	USA	Cross- sectional	133	19	Not declared (no)	—	Not declared	G, F, V, MD, MA, Cb, Pr, Fa, Fi, A, C, Fo, ^{bb} Ca, Fe	Yes (INQ ^{cc} ; Nutrition Facts, RDA ^{dd})	No	Yes (FGP ^{ee})
Greger and colleagues, 2002 ³⁶	USA	Cross- sectional	58	2	3; 4 (no)	3	No, but optional foods	En, Pr, A, C, Fo, Ca, Fe	Yes (RDA)	No	No
Teron and colleagues, 1999 ³⁷	Canada	Cross- sectional	85	18	Not declared (no)	3	No	En, Pr, A, B-12, C, D, Fo, Ni, Ri, T, Ca, Fe, Mg, Zn	No	Yes (RNI)	Yes (RNI)

(continued on next page)

Table. Characteristics of nine articles reporting the nutritional quality of food bags provided from food pantries (*continued*)

Author(s), year, reference	Country	Study design	No. of food bags	No. of food banks/ pantries	Investigated bag sizes (separate results)	Intended no. of days	Perishable items available	Nutritive outcome	Comparison of group mean with reference (reference)	Percentage of bags with inadequate supply (reference)	No. of days of adequate provision (reference)
Starkey, 1994 ³⁸	Canada	Cross- sectional	25	1	Not declared (no)	3	No	G, F/V, MD, MA, En, Pr, A, B-12, C, D, Fo, Ni, Ri, T	Yes (CFGHE, RNI)	No	No
Friedman, 1991 ³⁹	USA	Cross- sectional	68	4	Not declared (no)	3	Yes, sometimes	G, F/V, MD, MA, En, Pr, A, C, Ni, Ri, T, Ca, Fe, K, ^{ff} Ph ^{gg}	Yes (RDA)	No	No

^aG=grain products.^bF/V=fruit and vegetable.^cMD=milk and other dairy products.^dMA=meat and alternatives.^eEn=energy.^fCo=carbohydrates.^gPr=protein.^hFa=fat.ⁱFi=fiber.^jA=vitamin A.^kC=vitamin C.^lCa=Calcium.^mFe=Iron.ⁿZn=Zinc.^oCFGHE=Canadian Food Guide to Healthy Eating.^pRNI=Reference Nutrition Intake.^qV=vegetables.^rF=fruits.^sAGHE=Australian Guide to Healthy Eating.^tBecause no differences were found.^uB-12=vitamin B-12.^vD=vitamin D.^wNl=niacin.^xRi=riboflavin.^yT=thiamin.^zMg=magnesium.^{aa}DR=Dietary Reference Intake.^{bb}Fo=folate.^{cc}NO=Index of nutritional quality calculated as the nutrient content of the food bags' foods per 1,000 kcal, compared with a standard reference nutrient value adjusted per 1,000 kcal of intake.^{dd}RDA=Reference Dietary Allowance.^{ee}FGP=US Food Guide Pyramid.^{ff}K=potassium.^{gg}Ph=phosphorus.

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and one in Australia.³² Sample sizes ranged from four food bags³⁴ to >1,000 bags,⁴⁰ selected from single food pantries^{32-34,38,40} or 2³⁶ up to 19 pantries.³⁵ Pantries usually provided bags of diverse sizes, depending on the number of individuals in recipient's households, but only two studies reported results for different sizes separately.^{34,40} Bags were typically intended to last 3^{33,36-39} or 4 days^{34,40} and included mainly nonperishable staple foods. Additional perishable foods, such as fruit and/or vegetables, were provided when available,^{33,34,39,40} but only two studies calculated the nutritional quality for bags containing nonperishable foods and those containing nonperishable and perishable foods separately.^{34,40}

All studies collected data by recording the food items available in the bags. Adequacy of nutritive value of supplied food bags was mostly evaluated by comparing the mean nutritive value with references.^{32-36,38-40} Two studies calculated the percentage of bags with inadequate supply (Table).^{33,37} Three studies also calculated the number of days the bag content provided the recommended minimum number of servings per food group^{33,35} or nutrients.³⁷ The references used most often for food groups were national guidelines, such as the Canadian Food Guide to Healthy Eating or the Food Guide Pyramid,^{32-35,38,40} and for nutrients the Recommended Dietary Allowance or the Reference Nutrient Intake (Table).^{33,35-40}

Reported outcomes varied widely, with seven studies reporting supply of energy.^{33,34,36-40} All of the included studies also reported supply of at least one macronutrient.³³⁻⁴⁰ Seven studies evaluated the nutritive value of supplied food groups^{32-35,38-40} and eight studies reported the nutritional adequacy of between 5 and 12 micro-nutrients (Table).³³⁻⁴⁰

Risk of Bias of Included Studies

The nine included studies were rated, on average, with 2.7 of a maximum of 4 stars, where 4 stars was a low risk of bias.

Using the criterion "selection" of the Newcastle-Ottawa Scale³¹ adapted for cross-sectional studies, none of the studies were found to be nationally representative of food pantries. However, three studies were based on random samples of bags of one^{33,38} or two food pantries³⁹ and two were rated to be at least somewhat representative.^{34,37} While most studies controlled bag content for the number of days the bags were originated to last and adjusted for the number of individuals in the household, only two studies controlled for household composition by differentiating between adults and children (criterion "comparability").^{34,37} All studies except one, which did not describe the assessment of outcome,³⁴ used standardized methods to assess the outcome (criterion "outcome"). The detailed evaluation of the risk of bias for the included studies is available on request from the corresponding author.

Results of Included Studies

The study that investigated the food bags over 3 nonconsecutive years reported that the nutritional quality improved between 2006, 2010, and 2011 for almost all food groups and nutrients and all five bag sizes.⁴⁰ In this review, results are presented for the most recent year (2011) only.

For studies reporting results for studied food pantries or sizes of food bags separately, results were also reported separately in this review.

Overall Nutritional Quality

None of the studies investigated the overall nutritional quality of food provided by food pantries.

Energy

Figure 2 shows the mean energy supply reported by six studies along with recommendations of the Food and Agriculture Organization of the United Nations for energy intake given a moderate activity level (mean physical activity level

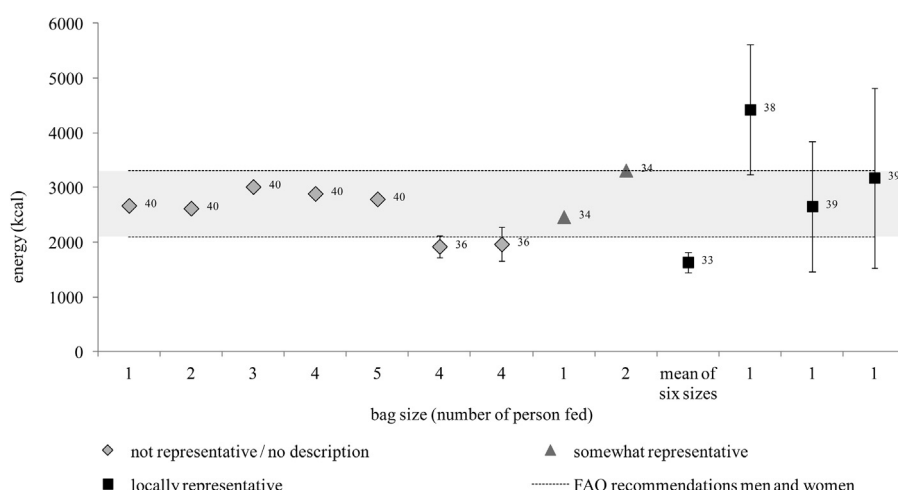


Figure 2. Mean supply of energy per person in food bags provided from food pantries reported in six studies. Note: each sign represents an average supply per person from the reviewed literature; the vertical lines represent standard deviations, where available; the gray space between lines represents the recommendations from the Food and Agriculture Organization of the United States (FAO). Greger and colleagues³⁶ reported the results for two pantries separately; Friedman³⁹ reported the results for urban and rural food pantries separately.

of 1.75) and an assumed body weight of 60 kg and 80 kg for women and men, respectively.⁴¹ Mean provision of energy met or exceeded recommendations in four of six studies (five of eight pantries) (Figure 2).^{34,38-40} Two papers reported the percentage of bags with inadequate energy supply and found that 33%³⁷ and 99%³³ of bags did not meet the recommendations (see Figure 3).

As seen in Figure 4, two studies calculated the mean number of days for which the bag content provided the recommended minimum energy. Large variations were evident within and between these two studies.^{33,37}

Food Groups

Dairy products were one of the food groups most often provided in inadequate amounts, as four of five studies reported an insufficient supply at least for some sizes (Figure 5).^{32,33,38,40} Three studies reported that the mean number of servings provided was adequate for the intended number of days for fruits and vegetables (F/V),^{34,38,40} but one Australian and one Canadian study reported inadequate supply of F/V.^{32,33} Supply of meat and alternatives exceeded recommendations in two studies,^{34,40} but was low in animal protein.^{34,40} Two studies reported insufficient provision of meat and alternatives^{32,33} and one reported adequate supply.³⁸ All five studies comparing provision of food groups with recommendations reported adequate provision of grain products for the intended number of days (Figure 5).^{32-34,38,40}

Supporting these results, in both studies calculating the minimum number of days for which the bag content provided the recommended minimum number of servings of food groups, milk products would last the least longest, with 3 days³⁵ and 0 days.³³ The supply of meat and alternatives would last longest (Figure 4).

Macronutrients and Micronutrients

While the mean supply of macronutrients mostly met recommendations, two studies, which were conducted in the same campus-based food bank at the same university at different times, reported a relatively low supply of fat

(Figure 5).^{34,40} Teron and Tarasuk³⁷ found 9% of bags supplied by 18 randomly selected food pantries in Toronto had an inadequate supply of protein (Figure 3), whereas the mean number of days of adequate supply was more than 6 days, clearly above the intended minimum of 3 days (Figure 5).

Considering nonperishable foods only, the amounts of vitamins A and C provided by six pantries were, on average, below or borderline above Recommended Dietary Allowance values with large variations (Figure 5).^{33,34,36,38-40} Folate, niacin, riboflavin, thiamin, and vitamins B-12 and D were, on average, provided in adequate amounts (Figure 5).^{33,37-39}

Mean supply of calcium, iron, and zinc was reported to be inadequate in some of the studies (Figure 5).^{33-36,40} Iron was mostly provided by beans, which is nonheme.^{33,34}

As seen in Figure 3, large percentages of investigated bags did not provide an adequate amount of vitamins A and D and calcium. However, large differences in the percentage of bags with inadequate supply were evident between the two studies reporting on these data. For instance, Irwin and colleagues³³ found 99% of bags provided inadequate amounts of vitamin C, whereas Teron and Tarasuk³⁷ reported that 14% of the 85 bags examined from 18 food pantries provided an inadequate supply of vitamin C.

Large variations within and between studies were also found for the estimated number of days of adequate supply of nutrients provided by the bags (Figure 4).

For instance, Teron and Tarasuk found the mean supply of vitamins A and C was adequate for 7 and 8 days, respectively.³⁷ In contrast, Irwin and colleagues³³ found vitamins A and C lasted only around 2 days and 1 day.

DISCUSSION

Systematically reviewing existing data from published data showed large variations in the supply of energy, food groups, and nutrients provided by food pantries between the included study samples. Two studies concluded that the food supply of food pantries was adequate,^{36,39} while seven studies found that the amount and type of food was inadequate for the number of days the food was intended to last.^{32-35,37,38,40}

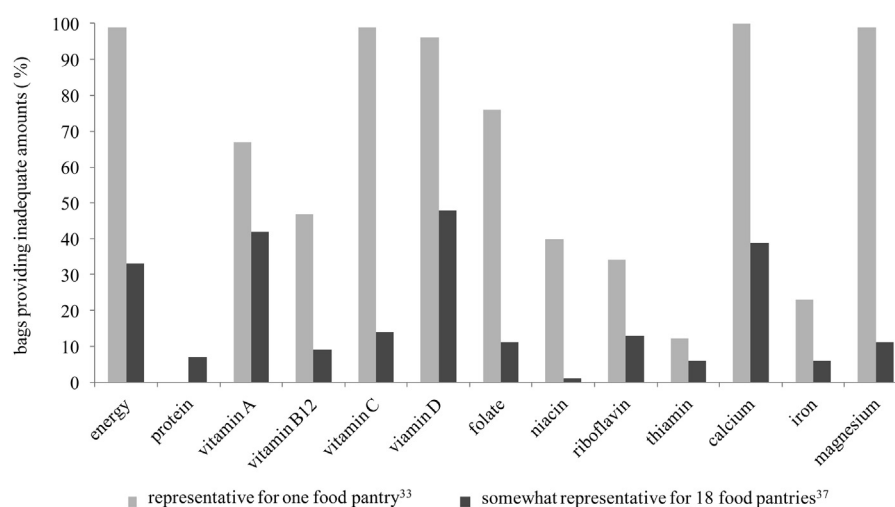


Figure 3. Percentage of food bags providing inadequate amounts of energy and nutrients reported in two studies. Note: each column represents the prevalence of inadequate supply reported in the review literature.

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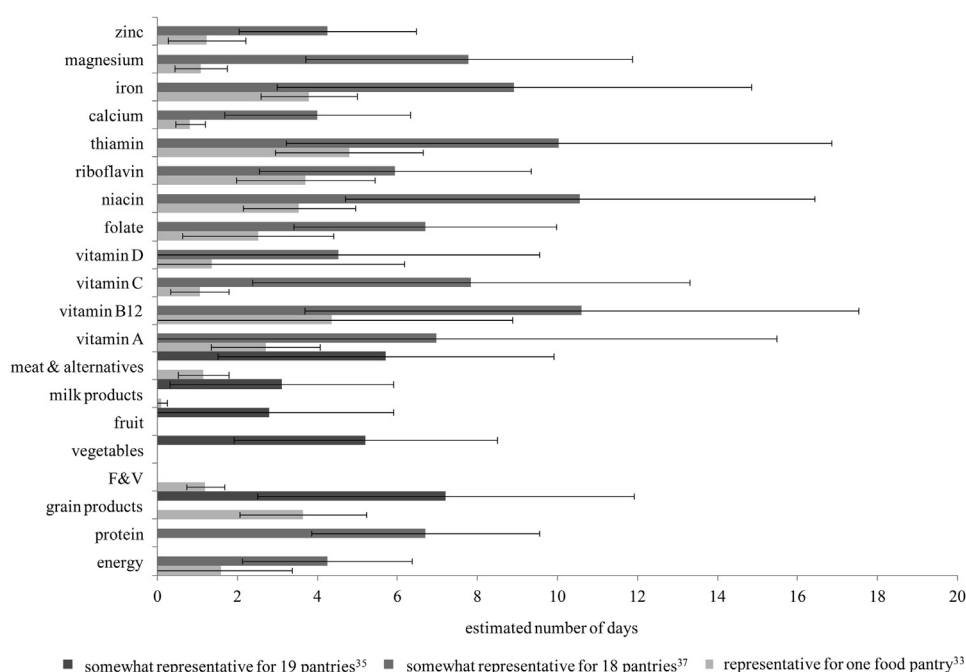


Figure 4. Mean number of days of inadequate provision of energy, food groups, and nutrients provided by food pantries reported in three articles. Note: each bar represents the mean number of days of adequate provision reported in the reviewed literature; the horizontal lines represent standard deviations, where available. F&V=fruit and vegetable.

Similar variations were observed within study samples with the results that even food groups and nutrients for which the mean supply was sufficient, a substantial percentage of the food bags did not meet recommendations. In particular, the supply of dairy products and products containing vitamin A, vitamin C, zinc, and calcium was insufficient for the intended number of days and people. F/V were mostly represented by tomato sauce, canned fruit or vegetables, and juice,^{34,38} but some food pantries provided perishable foods, such as fresh apples, carrots, and yogurt when available.^{34,39,40} These items improved the nutritional quality of bags, but their supply strongly depended on donations from retailers or manufacturers.⁴⁰

The observed low supply of dairy products and calcium is a finding of particular concern, given that many users of food pantries have been shown to have an inadequate intake of dairy products and calcium.⁴²⁻⁴⁴ Surprisingly, the mean supply of F/V was adequate in all studies except two, despite vitamins A and C often being supplied in amounts lower than recommended. In contrast, many studies investigating the dietary quality of users of food pantries reported that pantry users had an adequate intake of vitamins A and C, but an inadequate intake of F/V.⁴⁴⁻⁴⁷ Although the results of this review are not able to explain these mismatches, the discrepancy might be caused by differences in sampling and data collection. In addition, food pantries are likely not the only source of food for food pantry users.

Recipients of food pantries' assistance may buy additional food items to increase the nutritional value of their meals. As reported by Daponte and Bade⁴⁸ conducting focus groups among food pantry recipients in Pennsylvania, the provision of some ingredients for a complete meal, for instance, spaghetti sauce and pasta, may encourage recipients to buy additional food items, such as meat, in order to make their

meal "complete." Some food pantry users were reported to use multiple food pantries,^{36,49,50} indicating that food-insecure households tend to combine multiple food sources to keep their families fed.

Given that many clients rely on food bags from food pantries on a chronic basis,^{14,15,47,51-53} it has been argued that the initial mission of food pantries to distribute food in order to alleviate hunger in the short term no longer met the nutritional and social needs of typical food pantry users.⁵⁴

The observation that food pantries today may provide continuous food support rather than emergency food assistance might have contributed to the controversial debate about the role of food pantries in the whole food-security safety net.^{10,55,56} While there seems broad consent that food pantries' assistance serves as a supplement to federal food security activities,²⁴ in US national samples, only around 50%¹⁶ and in regional (convenience) samples between 15% and nearly 90% of food pantry users also used federal food assistance programs.^{50,57-60} In countries such as in Canada, France, or Germany, large percentages of food pantry users relied on social assistance,^{42,61,62} suggesting that social benefits may be insufficient to ensure that all households are able to acquire enough food to feed their families. A detailed analysis of the political, economical, and individual reasons for these observations is beyond the scope of this review. However, it is important to note that in diverse countries with different federal welfare systems, many food pantry users chronically rely on the assistance of charitable food assistance.

Some food pantries and food banks have begun to respond to the shifting needs of their clients. For instance, in 2004 the Food Bank of Central New York adopted a "no soda, no candy" donation policy, with the result of a substantial decrease in the amount of soda and candy accepted at the food bank.⁶³ To increase the supply of F/V, some food pantries and food banks

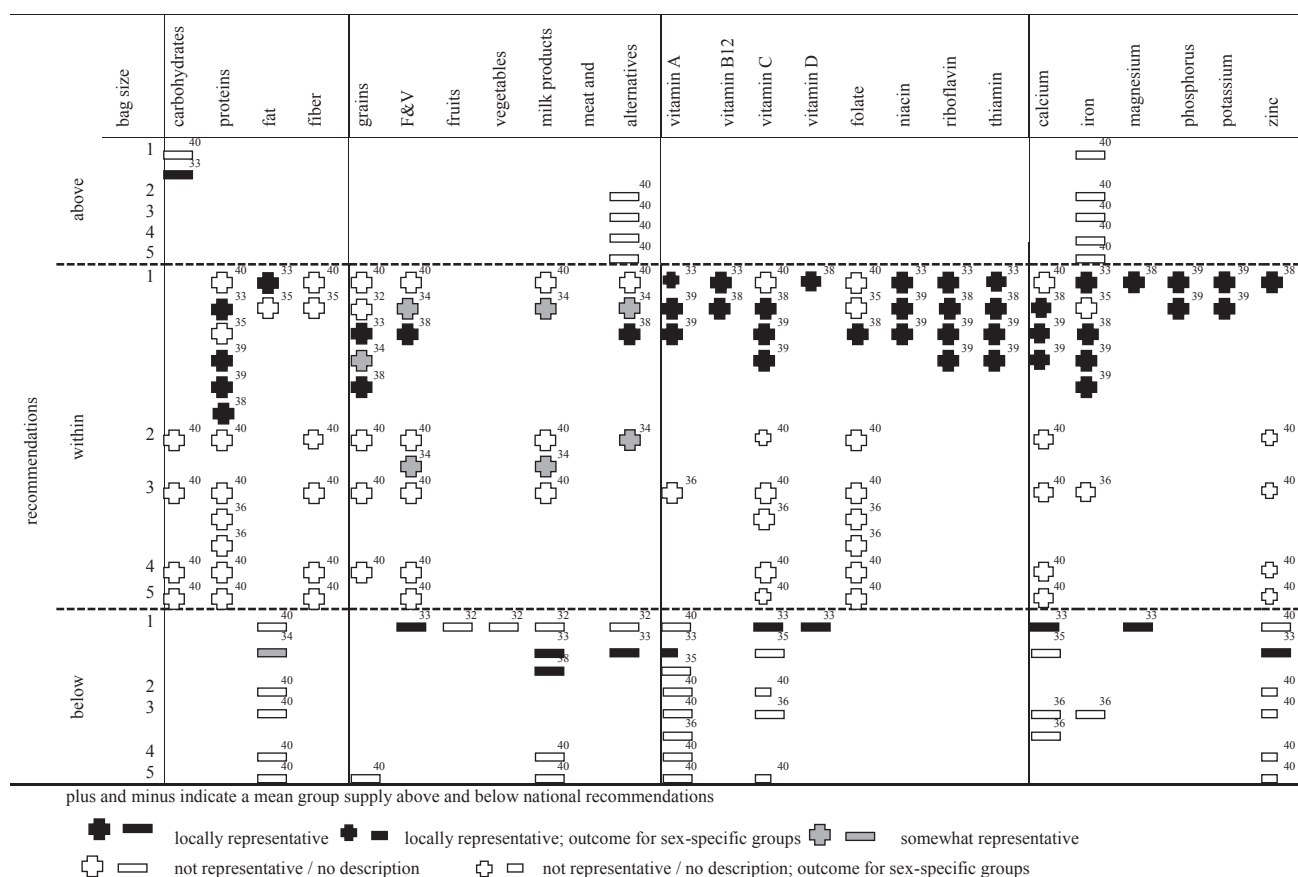


Figure 5. Comparisons of food supplied from food pantries with national recommendations reported in eight studies. Note: Jessri and colleagues⁴⁰ provided data for six bag sizes separately; supply of iron was more than recommended but non-heme; Willows and Au³⁴ presented data for two bag sizes separately; Greger and colleagues³⁶ reported data for two food pantries separately; Friedman³⁹ presented data for urban and rural food pantries separately.

have begun to work with local farmers and farmers' co-operatives.^{16,64} Supplying mainly fresh produce rather than nonperishable items may have particular benefits to the diet of low-income populations, as many low-income individuals state that they cannot afford fresh produce due to the high costs.⁶⁵⁻⁶⁷

While around half of the US food banks participating in a national online survey reported that they used "common sense" in classifying the nutritional quality of their food inventory,⁶⁸ other food banks and researchers applied a nutrition-profiling system to measure the food distributed in terms of MyPyramid days⁶⁹ or used linear programming to identify food items required to mitigate nutritional deficiencies in the food donations.⁷⁰ While these approaches may be useful for measuring nutritional quality of food distributed by food pantries, their potential benefits depend on whether food pantries have the personal and financial capacity and facilities to manage required changes in their food supply. For instance, fresh milk products, a food item that was found to be supplied in particularly low amounts, usually need to be stored in refrigerators; new food donors have to be gained; fresh produce involves prompt distributions from donors to clients requiring investments in trucks and fuel.^{54,71}

Staff of food banks often have concerns that if they implement bans of food items of low nutritional quality, donors may discontinue or reduce donations of all foods, including those of higher nutritional quality.^{68,71} Future research may explore the extent to which donors will accept or even encourage providing a more selective range of foods.

Many food banks are concerned about the nutritional quality of the food they distribute,^{68,71} but due to their charitable character they not only have to deal with limited resources but also might lack the professional background to develop strategies to improve nutritional quality. Therefore, they might benefit from national resources such as nutritional guidelines, public health programs, and reliable, user-friendly tools to assess the nutritional quality of foods. Trained registered dietitian nutritionists could assist food banks in developing donor policies and applying diet quality rating tools. Nutrition specialists could also provide nutrition education and cooking programs to clients and food safety training to staff.⁷²

Limitations

There are food pantries and food banks in many industrialized countries,^{16-18,73} but most of the identified articles reported studies from the United States or Canada only. Many

European food pantries and banks, including the German food bank network, are arguing to distribute more perishable food^{74,75} than those observed in the included US and Canadian studies. However, due to insufficient data, it is not possible to exactly quantify differences in types and amounts of supplied food between countries. In addition, welfare systems are different between countries in which studies were conducted, possibly affecting demands on the charitable food sector. Therefore, results of the included studies can hardly be generalized or transferred to all food pantry and food banks operating in high-income countries.

Finally, studies were excluded if they investigated food bank's or pantry's inventory only. For instance, Ross and colleagues⁷⁶ reported a significant increase in F/V donations in the six investigated food banks over the last years, whereas Campbell and colleagues⁶³ observed a notable reduction in donations of vegetables. The limitation of articles reporting the nutritional quality of food provided to clients might give an incomplete picture of food-related activities of food pantries and food banks.

Otherwise, articles reporting inventory data do not necessarily reflect the nutritional quality of food provided to food pantry users, which is the subject of this review.

CONCLUSIONS

Results of this review suggest that most studied food pantries were not able to provide amounts and types of foods that were adequate for a balanced diet for the intended number of days the food bags were declared to last. Given the direct provision of food items (and not prepared meals), food pantries likely have a strong influence on users' diets, resulting in an immense potential to address malnutrition in vulnerable population groups.

The future success of food banks and food pantries may be determined by their ability to respond to the shifting nutritional needs of their clients. Increasing the distribution of perishable foods, such as fresh F/V, whole grains, and milk products, is likely to have the potential to improve the diet quality of food pantry users. By focusing on selected nutritious foods and providing educational and/or practical interventions, the institutionalized food bank net might have the chance to be developed into an individual-oriented public health provider in the future. Changing the claim to provide a full supply for a certain number of days to the distribution of perishable, nutrient-dense foods as an addition to clients' own resources requires the clients' ability to cover their basic needs with own resources. In the absence of a political solution, many food pantry users have no alternative to the charitable food relief, as they simply do not have enough resources to feed themselves and their families. The problem's solution has to be a political one and cannot be delegated to charities. Due to the unpredictable nature of food donations, they are hardly able to provide a reliable full menu plan and it is our profound conviction that they should not have to.

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For more information on the subject discussed in this article, see the Sites in Review in this month's New in Review section.

AUTHOR INFORMATION

A. Simmet is a PhD student, J. Depa is a PhD student and research associate, and N. Stroebele-Benschop is a full professor, Institute of Clinical Nutrition, University of Hohenheim, Stuttgart, Germany. P. Tinnemann is Head of Global Health Science Unit, Institute for Social Medicine, Epidemiology, and Health Economics Charité-Universitätsmedizin Berlin, Berlin, Germany.

Address correspondence to: Anja Simmet, Dipl.-Ges.oec., Institute of Clinical Nutrition, University of Hohenheim, Fruwirthstr 12, 70599 Stuttgart, Germany. E-mail: Anja.Simmet@uni-hohenheim.de

STATEMENT OF POTENTIAL CONFLICT OF INTEREST

No potential conflict of interest was reported by the authors.

FUNDING/SUPPORT

There is no funding to disclose.

PROSPERO Reg. No. CRD42015024509.

Chapter 4

The German food banks and its users – a cross-sectional study

Simmet A, Tinnemann P, Stroebele-Benschop N.

Int J Environ Res Public Health. 2018;15(7). doi:10.3390/ijerph15071485



Article

The German Food Bank System and Its Users—A Cross-Sectional Study

Anja Simmet ^{1,*}, Peter Tinnemann ² and Nanette Stroebele-Benschop ¹

¹ Institute of Nutritional Medicine, University of Hohenheim, 70593 Stuttgart, Germany; N.Stroebele@uni-hohenheim.de

² Institute for Social Medicine, Epidemiology, and Health Economics at the Charité University Medical Center Berlin, 10117 Berlin, Germany; peter.tinnemann@charite.de

* Correspondence: Anja.Simmet@uni-hohenheim.de; Tel.: +49-176-2288-9784

Received: 12 June 2018; Accepted: 12 July 2018; Published: 13 July 2018



Abstract: Although food banks are a well-known resource for low-income people struggling to meet their food needs, they have rarely been investigated on a large scale. This study aims to contribute to the actual debate about the potential and limitations of food banks to decrease the prevalence of food insecurity by providing a representative picture of the German food bank system and its users. Publicly accessible data were used to map residents, public welfare recipients, and food banks. In addition, a comprehensive survey was distributed to all 934 “Tafel” food banks. The results show that nearly all residents and welfare recipients have access to at least one food bank located in the districts in which they reside. Differences in the density of food banks exist between eastern and western Germany. Food banks provide mainly healthy fresh food, but they heavily rely on food donations from local retailers and on volunteer labor. Although changes in the number of user households by income seem to mirror trends in the number of welfare recipients, food bank users appear to represent only a fraction of the food-insecure population in Germany. Food banks might have the potential to improve users’ diet and food security, but they are not able to reach all food-insecure residents in Germany.

Keywords: food bank; food insecurity; welfare recipients; poverty; food supply; food aid

1. Introduction

Over the last decades, food banks have become a critical food source for people with low income in many high-income countries including the USA [1], Canada [2], Australia [3], and in several European countries [4–7]. Although operation and organization of food banks differ widely between and even within countries, food banks are generally operated by charitable organizations that collect, store, and distribute food donated by retailers, the food industry, and farmers to needy people or to other charitable organizations [8].

Despite the differences in the social security systems across high-income countries, there seem to be commonalities in the characterization of food bank users. For instance, food banks initially aimed to provide temporary emergency assistance to people with financial hardships, whereas users today tend to visit food banks regularly for many years [2,6].

In Germany, the food bank system is called “Tafel” (table) and was initiated in 1993 to help homeless people in Berlin. To date, over 930 local branches of the Tafel food banks have been established throughout the country and they no longer limit assistance to homeless people but assist people with a very low or no income. Food banks usually apply eligibility criteria such as an income at or below the federal unemployment pay (Arbeitslosengeld II) and residence in the coverage area of the food bank [9,10], but in contrast to food banks in other countries such as in the UK [11] and

the Netherlands [12], there is no referral system and social workers do not need to be involved. Most food banks in Germany collaborate as members under the umbrella of the federal association “Tafel Deutschland” (Table Germany). Member food banks are solely financed by donations and receive no public financing [13]. As defined by the European Food Banks Federation, a member of which Tafel Deutschland just recently became [14], food banks serve as charitable organizations that help the poor. In this paper we use the expression “food bank” to describe all Tafel entities.

One of the few studies undertaken among food bank users in Germany showed that 70% of over 1000 participating food bank users in three German cities suffered from food insecurity [15]. Thus, food bank users in Germany seem to be less food insecure compared with food bank users in the USA [1], Canada [16], and the Netherlands [7], but they are seven to ten times more often food insecure than the general population [17]. In accordance with studies conducted in other countries [4,6,7], the study found a high prevalence of overweightness and obesity among food bank users (around 68%) [15], in particular among users born outside of Germany [18]. In another study, Depa et al. also revealed that the proportion of people who reported consuming fruit at least daily was lower among the 276 food bank users enrolled than among the representative population with a low socioeconomic status [6]. In addition, around 60% of participating food bank users reported suffering from at least one chronic disease including hypertension, diabetes, or mental illnesses [6]. In summary and in line with international results [4,7,19,20], food bank users in Germany seem to be a very vulnerable population group at high risk of having unfavorable health behaviors and health conditions.

Food banks may serve as an important civil societal resource through their low-threshold services and their nationwide structure. Although the German welfare system is considered more generous compared with those of other countries [21], the Tafel food bank system is the only nationwide immediate food assistance for people struggling to meet their food needs. However, in Germany there is no legal claim to a food bank’s assistance and the nationwide distribution of food banks in relation to the general population and welfare recipients is unknown. Information on food banks’ activities as well as user characteristics are missing on the national level. Studies on the food bank movement have only included samples from few regions or cities [6,9,15,22,23]. The evolution of food banks and rough estimates of the number of users have been illustrated through reports by Tafel Deutschland [24], but a scientific approach to characterize and describe the food bank system and its users on a national level is still missing.

This study aims to provide a representative overview of the German food bank system and its users by

- presenting the coverage rate of food banks in relation to the proportion of welfare recipients in German districts;
- illustrating food banks’ structures, activities, and resources;
- counting and characterizing food bank users by source of household income;
- investigating the association of the number of food bank users and food bank resources and the proportion of welfare recipients in the district the food bank is located in, as well as between the main challenges of food banks and resources and demands of the food banks.

To do this, an explorative cross-sectional study was conducted. Freely accessible data of Tafel Deutschland and the Federal Office of Statistics were used and a comprehensive survey was distributed among all food banks associated with Tafel Deutschland. Illustrating the resources and demands of the food bank system will help to evaluate the potential of food banks to improve the users’ food security level and dietary quality.

2. Materials and Methods

The study area included the entire country of Germany consisting of 432 districts and district-free cities (counties, “Landkreise, kreisfreie Städte”) and of 11,437 municipalities (“Gemeinden”) [25]. Tafel Deutschland provided a current list of all registered member food banks [26].

The cross-sectional survey took place from 13 September until 5 December 2017. All food banks received an email containing information about the study, its aims, the voluntary basis of participation, and data protection. The email included a link to a comprehensive online survey, which took approximately 60 min to complete. The link to the survey was also available as a bulletin posted on the intranet of Tafel Deutschland, which is accessible to all member food banks. The person responsible for the local food bank was requested to respond to the survey. Nine fuel vouchers (three of each, valued at €500, €300, and €100) were raffled among all participating food banks. By 23 October 2017, 281 of the 934 food banks had participated in the survey. In order to increase participation amongst food banks, a shorter version of the survey was developed and all food banks that had not yet participated received a reminder email containing the link to the shortened survey, which took approximately 30 min to complete. Additionally, food banks were contacted by telephone and encouraged to participate by answering the survey over the phone. This increased participation in the survey by another 273 additional food banks.

The study was approved by the Ethics Committee of the University of Hohenheim, Stuttgart.

2.1. Measures

The addresses of all food banks associated to Tafel Deutschland were received from Tafel Deutschland [26]. The most recent publicly available data on recipients of social welfare at district level is from the end of 2015 [27]. Publicly available shape files of German districts and district-free cities as well as of municipalities with the number of residents were retrieved from the Service Center of the Federal Government for Geo-Information and Geodesy [25].

The development of the survey questionnaire was guided by intense literature research [1,8,28,29] and through consultations with staff from Tafel Deutschland. It contained questions of the following domains: distribution schemes, services and projects of the food bank, food bank users, distributed food, food donors, food bank staff, and perceived challenges of the food bank in 2017. In addition, the long version of the questionnaire included questions on food bank's facilities including storage space, waiting room(s) and transportation vehicles, organic waste accrued at the local food banks, and use of materials of the umbrella organization Tafel Deutschland. Due to reasons of clarity, these latter topics will not be included in the present analyses. Since the majority of the local food banks were not able to state the exact change in weight of food distributed or the number of users per month in 2017 compared to 2016, they were asked to rank possible changes from -2 (more than 20% less in 2017 compared to 2016), -1 (1–20% less), 0 (equal), $+1$ (1–20% more), $+2$ (more than 20% more) for both number of users and donated food weight.

The shortened questionnaire also covered all of the domains presented by this article, but in less detail (e.g., by asking for only the number of users rather than for the number of users and the number of visits). A selection of the questionnaire content is provided in the Supplementary File 1.

2.2. Geographical and Statistical Analyses

Addresses of all food banks were geocoded using MMQGIS [30] in the freely available GIS (geographic information system) application QGIS (version 2.18.16) [31].

Districts and municipalities with and without at least one food bank available were identified by using the point-in-polygon function in QGIS [31].

The coverage rate of the food banks was determined by calculating the number of districts and municipalities with at least one food bank located in them. Moreover, the number and proportion of residents and of residents receiving welfare benefits living in a district or district-free city with at least one food bank was calculated. Differences in the number of residents between municipalities with and without at least one food bank and differences in the number of residents, the number of welfare recipients, and the proportion of welfare recipients between districts with and without at least one food bank were tested by the *t*-test for independent samples.

Descriptive statistics (mean, standard deviation, median, sum, percentage) were calculated to illustrate the basic characteristics of the participating food banks, the food bank users as well as changes in the number of food bank users per month in 2017 compared to 2016, the food distributed as well as changes in the weight of food distributed per month in 2017 compared to 2016, the food donors, the food bank workers, and the challenges of the participating food banks.

Differences in the central tendencies of ordinal data or data not normally distributed were tested with the Mann–Whitney test for two groups; the Kruskal–Wallis test was used for more than two groups. Differences in continuous data were tested with *t*-tests for two groups.

Multivariate linear regression models were applied to identify resources of local food banks and the percentage of welfare recipients in the district the food bank was located in that predicted the number of users per month. Variables included in the regression analyses were the number of programs offered, the weight of food distributed per month, the number of workers, the number of services related to food, the number of services unrelated to food, the weight of food each user received per month, the percentage of volunteers of all workers, and the number of welfare recipients in percentage of the population in the district the food bank was located in. Backward selection based on Akaike information criterion was applied to receive a parsimonious model.

To examine the associations of both major challenges of participating food banks (lack of volunteers, lack of food) with the resources and demands of the food bank, logistic regressions were conducted. In the first logistic model, the variables of resources and demands in 2017 were included in the analyses. In the second logistic model, ranked possible changes in the number of users and the weight of food distributed in 2017 compared to in 2016 were included.

Since the number of users per month and the weight of food distributed per month were highly skewed, these variables were log-transformed before conducting regression analyses.

A *p*-value of <0.05 was considered to be significant. Data cleaning, preparation, and visualization were performed using Microsoft Excel 2007 (Microsoft Corporation, Redmond, WA, USA). Statistical analyses were performed using R, version 3.4.3 (R Foundation for Statistical Computing, Vienna, Austria) [32].

3. Results

At first, results of the geographic analyses will be shown before presenting the descriptive survey results including services provided by food banks, food bank users, food distributed by food banks, food bank workers, and challenges of food banks. Finally, results of multiple regression analyses will be shown.

3.1. Geographic Analyses

There was at least one food bank in 6.89% ($n = 779$) of all German municipalities in 2015, but 53.02% of residents lived in municipalities with at least one food bank. Municipalities with at least one food bank had a significantly larger number of residents ($M = 55,935$) than municipalities without a food bank ($(M = 3667)$, $t(778.23) = -8.4648$, $p < 0.0001$). When considering the municipalities with at least 10,000 residents, which correspond to a so-called “big town” (“große Kleinstadt”) or larger, the percentage of municipalities with at least one food bank increased to 41.18% ($n = 649$).

At the next level of administrative units, 88.81% of districts had a least one food bank. The districts with at least one food bank had a larger number of residents ($M = 214,983$) than districts without a food bank ($(M=120,592)$, $t(280.58) = -5.9377$, $p < 0.0001$). Districts with and without at least one food bank, however, did not differ in the number of welfare recipients as a percentage of the population ($t(52.797) = -1.5547$, $p = 0.13$). Overall, 93.40% of all residents and 94.52% of welfare recipients lived in districts in which they had access to at least one food bank.

As illustrated by Figure 1, the number of food banks per 10,000 welfare recipients was larger in districts of western Germany ($M = 2.12$) than in districts of eastern Germany ($(M = 1.37)$, $t(162.54) = 4.2424$, $p < 0.0001$).

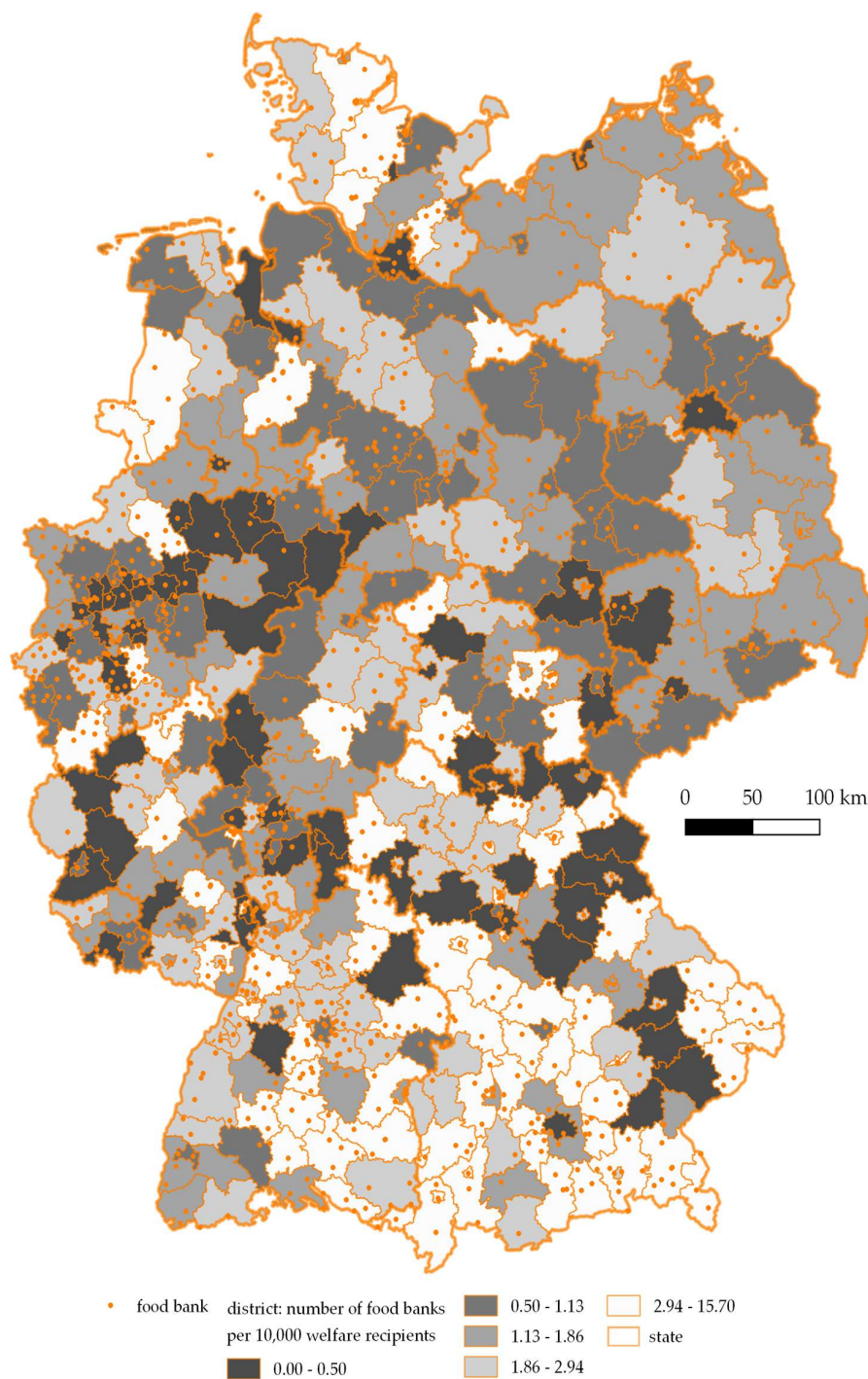


Figure 1. Number of food banks per 10,000 welfare recipients per district in Germany, 2014/2017.

3.2. Survey

A total of 554 questionnaires—329 from the comprehensive online survey, 130 from the survey by phone, and 95 from the short online survey—were analyzed. Due to missing values and invalid data, fewer participating food banks were included in most of the further analyses. Food banks participating in the survey and those not participating in the survey did not differ in the type of community ($\chi(5) = 9.8542, p = 0.079$), in the number of residents living in the district the food bank was located in ($t(780.26) = -0.094, p = 0.93$), or in the number of welfare recipients living in the district the food bank was located in ($t(660.29) = -0.33, p = 0.74$).

3.2.1. Services Provided by Food Banks

The schemes for the distribution of the foods largely varied between participating food banks. The large majority of them distributed foods in more or less predetermined quantities based on household size for a small fee or at no cost at distribution points (84.85% of participating food banks). In contrast, food banks in the Southern state of Germany Baden-Württemberg (state-specific data not shown) tended to operate as “social supermarkets” where eligible individuals can purchase food at a greatly reduced price (18.25%). The difference between a distribution point and a “social supermarket” is that in the latter the clients pay for each food product they want to buy, whereas in a distribution point they pay a predetermined small fee. Whether clients are allowed to choose the food items they want differs between distribution points. On average, each food bank managed 2.21 (SD 3.0) distribution points and/or social supermarkets. Overall, 7.48% of the participating food banks delivered food to other organizations such as women’s shelters, youth centers, and drug rehabilitation facilities and served as so-called delivery food banks. In addition to these schemes, 10.40% of participating food banks also regularly supplied warm soups or other meals, whereas only a few of the participating food banks (3.28%) offer children a warm lunch at a so-called “Kinder Tafel” cafeteria. On average, each food bank managed 2.26 (SD 2.81) service programs (distribution points, social supermarkets, delivery food banks, soup kitchens, and/or children’s food banks).

The majority of the distribution points (75.50%) and delivery food banks (56.67%) allowed users to collect food once per week, whereas supermarket-like shops (37.14%), soup kitchens (71.15%), and children’s food banks (62.50%) tended to be open every day.

In addition to these standard schemes, 45% of participating food banks offered at least one additional service related to food, nutrition, or cooking such as a delivery service for home-dwelling elderly or disabled clients, offerings of coffee and cake during the hours of food distribution, and/or offerings of food recipes; 50% of them provided at least one additional service unrelated to food such as a thrift store, school supplies and toys, and/or social counseling.

3.2.2. Food Bank Users

Descriptive statistics of food bank users are presented in Table 1. Initially, data of 415 food banks were available. Since data of 49 food banks were inconsistent (number of child recipients aged less than 18 years and of adult users did not equal the overall number of users), data of 366 food banks were included in the analyses. As indicated by the large standard deviations, very large variations in the number of users were observed between participating food banks.

There were no significant differences in the number of users between food banks located in western or eastern Germany ($U = 5090$, $p = 0.82$).

For 89 districts, all available food banks participated in the survey. On average, 179 (SD = 137) welfare recipients per 1000 welfare recipients and 17 (SD = 17) residents of 1000 residents used a food bank in the district.

For 152 food banks, data of user households by source of household income were available (Table 1).

As illustrated in Figure 2, more than half of the participating food banks reported that the number of users per month had increased in 2017 compared with in 2016. The weighted mean of reported scale points indicated an increase of the number of users per month in 2017 compared with 2016 (Figure 3). The ranked increase was higher among child recipients than among adult users, but the difference was not statistically significant ($U = 62,648$, $p = 0.20$).

Participating food banks reported most changes for households receiving support according to the Asylum Seekers Benefit Act (Figure 2). The Kruskal–Wallis test revealed that there was a significant difference in the ranks indicating changes in the number of households per month in 2017 compared with 2016 between the household groups by income ($H(7) = 16.949$, $p = 0.018$). A posthoc test using Mann–Whitney tests with Bonferroni correction showed that the ranks for households receiving a low retirement or minimum social security benefits for the elderly was significantly higher than the ranks

for households receiving student grants ($p = 0.007$), for households with labor income ($p = 0.022$), and for households with other income ($p = 0.022$).

Table 1. Sociodemographic characteristics of food bank users in Germany, 2017.

Characteristics of Food Bank Users	Mean	Standard Deviation	Median	% of Users
Users	1559	3126	726	100
Adult users	1120	2684	480	72
Child recipients	440	724	209	28
Households	696	952	300	/
Characteristics of Households of Food Bank Users	Mean	Standard Deviation	Median	% of Households ²
Households receiving unemployment pay II ¹	260	436	115	49
Households receiving social security for asylum seekers	139	255	80	26
Senior households receiving low pension or minimum social security	83	131	40	16
Households receiving minimum security or disability benefits	37	63	18	7
Households with low labor income	10	25	0	2
Households with other income/no income	6	19	0	1

Note: For the characteristics of food bank users, data of 366 participating food banks were available and for the characteristics of households of food bank users, data of 152 participating food banks were available; excl. individuals who receive food from other noncharitable organizations such as women's shelters, schools, youth clubs, etc. that are delivered by delivery food banks; ¹ unemployment pay II is a basic security benefit for job-seekers; ² in rounded percent of the overall sum of households for which the source of household income was available.

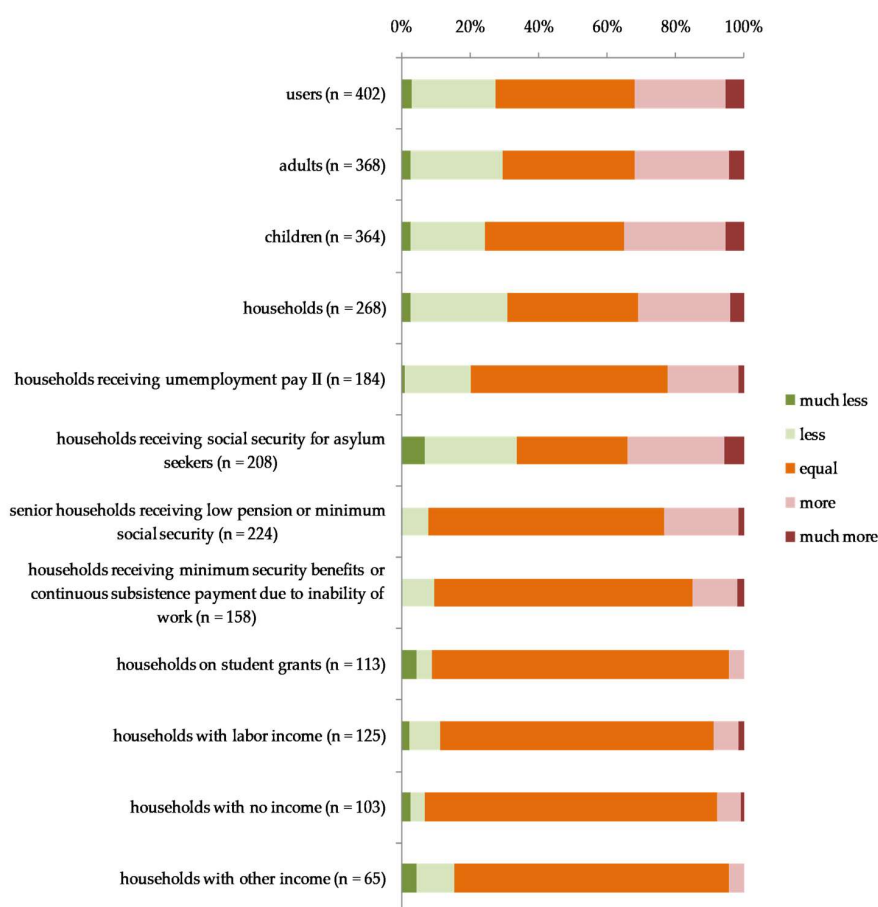


Figure 2. Comparison of the number of users of participating food banks per month in 2017 and 2016 in percent of participating food banks.

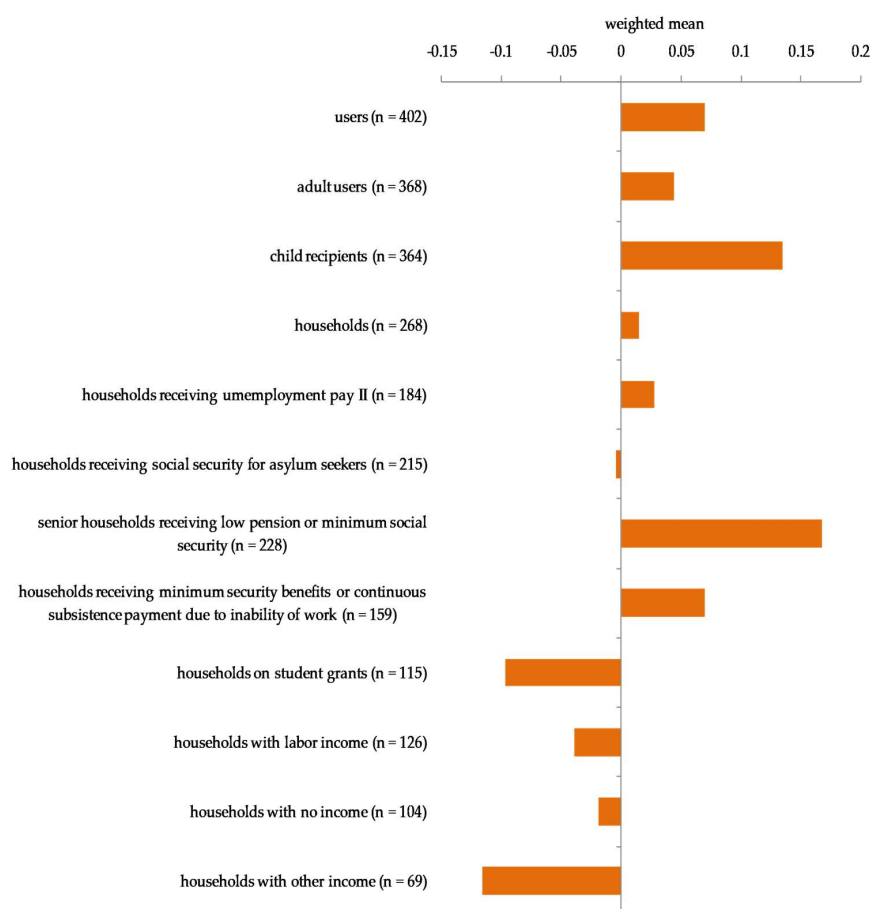


Figure 3. Number of users of participating food banks per month in 2017 compared with 2016 on a five-point scale.

3.2.3. Food Distributed by Food Banks

The mean weight of the food distributed monthly by each of the 328 food banks for which data were available amounted to 25.97 t (SD = 51.59). However, large variations could be observed and the distribution was highly skewed (median = 8.00 t). The mean weight of food per user per month was 23.92 kg (SD = 77.58 kg) and the median was 11.28 kg. There were no significant differences in the weight of the distributed food per month ($U = 4647$, $p = 0.24$) or in the weight of food per user per month between food banks in western and eastern Germany ($U = 4547$, $p = 0.16$).

The large majority of distributed food (82.29%) came from regular donors such as retailers. Less than 20% of distributed food came from single events or irregular donors (8.02%), the federal association Tafel Deutschland, state associations, and/or local distribution centers (7.68%), and/or from other sources (2.72%). Types of regular food donors are shown in Figure 4. Food banks reported receiving food from an average of 32.32 (SD = 34.25) regular donors.

As seen in Figure 5, the majority of food distributed per month was fruits and vegetables, followed by baked goods such as bread and pastries, milk products, and meat and meat products. Dry and frozen food, beverages, and sweets were distributed only in relatively small amounts. With the exception of baked goods, the amounts of almost all food groups were reported to have decreased in 2017 compared with 2016, as illustrated by Figure 6.

Overall, 47.45% of participating food banks reported that they infrequently (25.12%), sometimes (defined as once per four distribution days; 12.56%), often (defined as twice to thrice per four distribution days; 6.05%), or always (3.72%) had supply constraints, i.e., not enough food to cover demand in the months prior to the survey. Nearly 75% (74.51%) of them responded with a reduction

in the amount of distributed food per household, 29.41% attempted to acquire more food from donors, 11.76% of them limited the membership and turned people seeking assistance away, and 7.48% implemented other measures to restrict access or to increase supply.

In contrast, 49.25% of participating food banks reported that they infrequently (32.84%), sometimes (11.94%), or always (4.48%) collected more food than they needed in the months before the survey. The majority of them (79.80%) distributed food they did not need to other nearby food banks, 51.52% of them froze or preserved food, 41.41% distributed excess food to other charitable organizations, 40.40% supplied users with more food, 13.13% threw excess food away, and 21.21% implemented other measures such as delivering the food to farmers for animal feed.

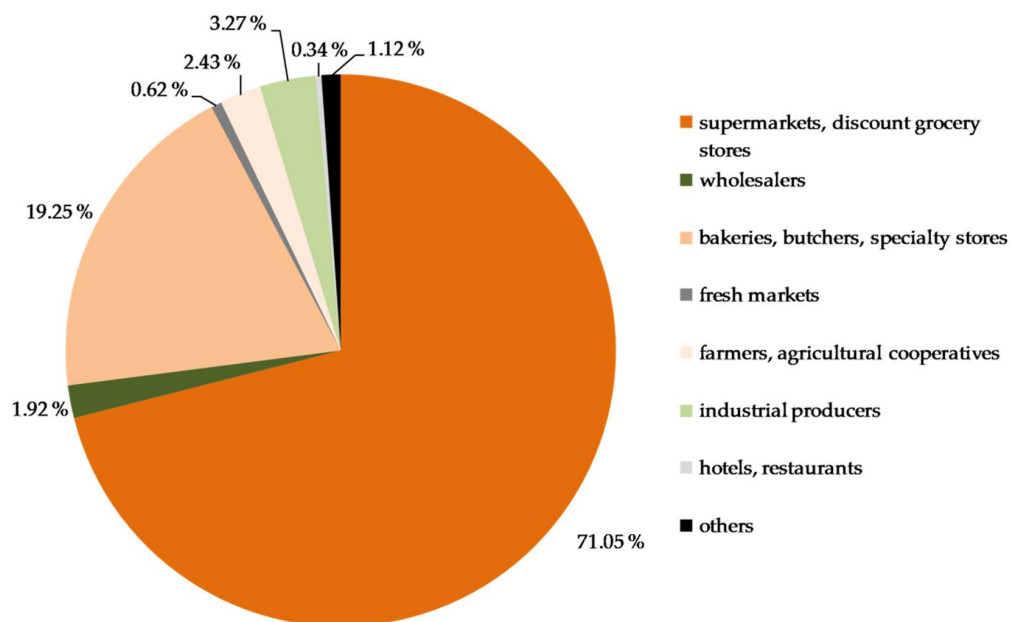


Figure 4. Types of regular food donors of participating food banks in percent, 2017.

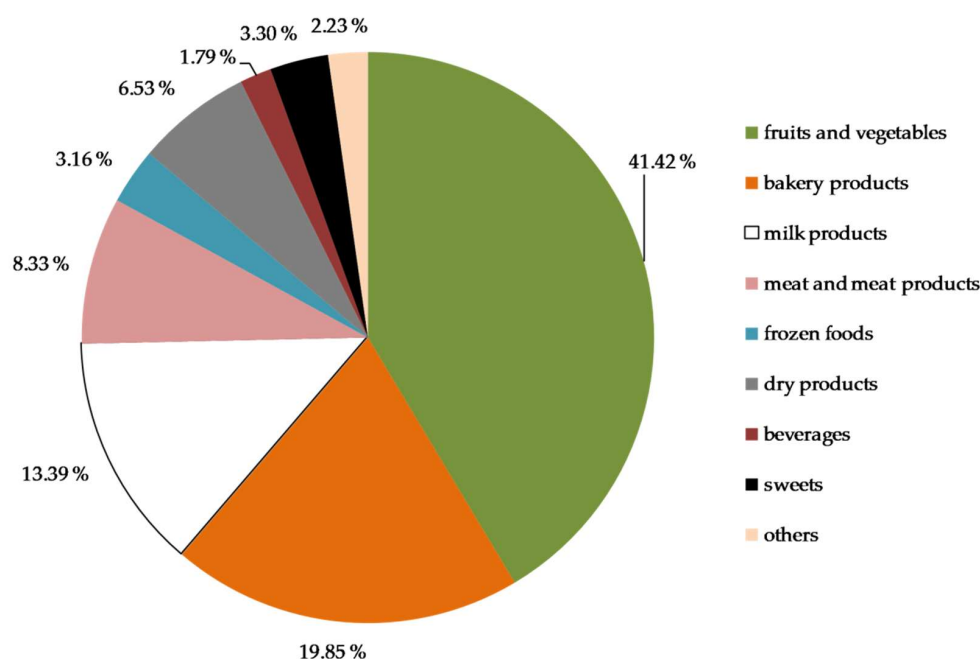


Figure 5. Categories of food distributed by participating food banks in percent, 2017.

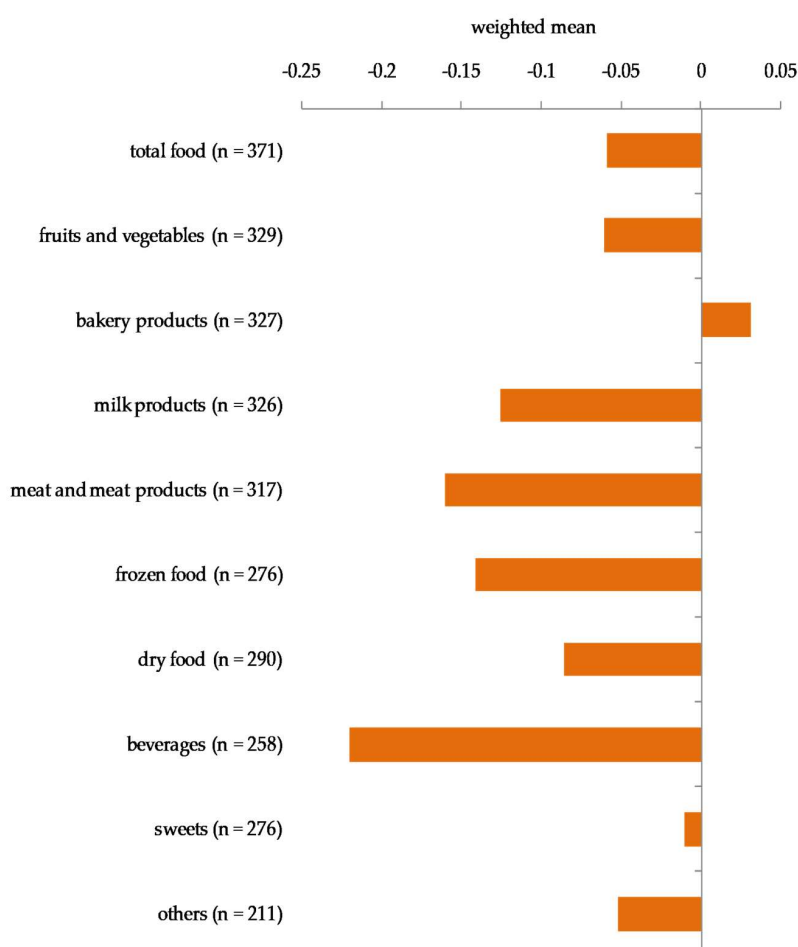


Figure 6. Weight of food distributed monthly by participating food banks in 2017 compared with 2016 on a five-point scale.

3.2.4. Food Bank Workers

The large majority (89.97%) of people working in the 387 participating food banks for which data were available were volunteers. On average, every participating food bank had 59 (SD = 56) volunteers with large variations being observed. Volunteers were mostly 65 years or older (68.46% of volunteers) and female (61.52%).

Overall, 64.16% of the participating food banks had some paid staff, of which the mean number ($M = 7$, $SD = 21$) was much lower than that of volunteers. The majority of paid workers were participating in a government-subsidized employment scheme, the so-called One-Euro-Jobs (42.01% of paid workers). Only a few amongst the paid staff were permanent employees (0.67% of paid workers). The number of workers ($M = 33.02$, $SD = 33.90$) as well as the number of volunteers as a percent of the total number of workers ($M = 65.69$, $SD = 28.47$) were significantly lower for food banks located in eastern Germany than for those located in western Germany (number of workers: $M = 82.00$, $SD = 74.01$, $t(183.51) = 6.96$, $p < 0.0001$; number of volunteers in percent of total number of workers: $M = 91.48$, $SD = 14.47$, $t(58.01) = 6.32$, $p < 0.0001$).

Nearly 20% of all workers (volunteers and paid staff) were eligible to use a Tafel food bank and approximately 2% of all workers were refugees.

On average, volunteers worked 33.23 h ($SD = 38.02$) and paid workers worked 79.55 h ($SD = 47.80$) per month in a food bank with large variations observed among food banks.

3.2.5. Challenges of Food Banks

Overall, 34.27% of the 321 participating food banks for which data were available stated that they had no challenges or problems in the last months. If problems were reported, the most frequent problem was a lack of volunteers (33.96% of participating food banks), in particular of volunteers with driver licenses who could pick up the food from retailers, followed by a lack of food (19.63%), in particular of milk products, meat, and sausages, and a lack of financial resources as well as lack of appropriate space (16.51% each).

3.2.6. Associations

Results of multiple linear regression of the log-transformed number of Tafel users on predictors are shown in Table 2. The predictors accounted for 39.44% of the explained variance in the number of users.

Table 2. Association between the log-transformed number of food bank users and food bank resources and district character. Results of multiple linear regression analyses.

	β	<i>p</i> Value	95% CI
Intercept	5.23	<0.0001	4.93, 5.53
Number of service programs ^a	0.044	0.05	−0.0007, 0.090
Weight of distributed food per month ^b	0.197	<0.0001	0.13, 0.26
Number of workers ^c	0.005	<0.0001	0.003, 0.006
Number of additional services unrelated to food	0.065	0.13	−0.020, 0.15
Number of welfare recipients in percent of the population	0.070	<0.0001	0.038, 0.010

^a including distribution points, social supermarkets, delivery food banks, soup kitchens, and children's food banks; ^b log-transformed; ^c including volunteers and paid workers; β : unstandardized regression coefficient; CI: confidence interval.

The odds of having a lack of volunteers were significantly associated with working time per month per volunteer ($b = 0.011$, 95% CI 0.001, 0.020, OR 1.01, $p = 0.026$), but not with the log-transformed number of users per month, the weight of food distributed per month, or the number of volunteers in percent of the total number of workers. The model analyzing the association of a lack of volunteers and ranked possible changes in the weight of food distributed and the number of people served revealed that the odds of having a lack of volunteers decreased with an increase of food distributed per month in 2017 compared with 2016 ($b = -0.57$, 95% CI -1.04 , -0.12 , OR 0.57, $p = 0.015$).

The odds of having a lack of food was not significantly associated with the log-transformed number of users, the log-transformed weight of food distributed per month, the number of workers, the number of programs, or the number of food donors.

However, in the models analyzing the association of a lack of food and ranked possible changes in the weight of food per month and in the number of users per month in 2017 compared with 2016, the odds of having a lack of food significantly increased with a decrease of food per month in 2017 compared with in 2016 (Table 3).

Table 3. Association between the log of having a lack of food and the ranked possible changes in the number of users and the distributed food. Results of logistic regression analyses.

	β	<i>p</i> Value	95% CI	OR
Intercept	−1.82	<0.0001	−2.27, −1.42	0.16
Ranged possible changes in the weight of food per month in 2017 compared with 2016	−1.16	0.0001	−1.78, −0.60	0.31
Ranged possible changes in the number of users per month in 2017 compared with 2016	0.31	0.16	−0.12, 0.76	1.37

β : unstandardized regression coefficient; CI: confidence interval; OR: odds ratio.

4. Discussion

This study revealed that a Tafel food bank was in operation in more than every second “big town” and nearly all residents and welfare recipients had access to at least one food bank in the district they lived in. Thus, Tafel Deutschland appears to provide a comprehensive net of local food banks throughout the country. In addition to the regular supply of mainly fresh produce, many food banks provided additional services such as social counseling and meal recipes, which may directly or indirectly impact users’ food security. However, the density of food banks per 10,000 welfare recipients differed between parts of former East and West Germany with a lower density in eastern parts.

An analysis of the roots of this pattern is beyond the scope of this paper, but an explanation might be that the total number of workers as well as the number of volunteers as a percentage of all workers was significantly lower among participating food banks located in eastern compared with western Germany. Differences in volunteer engagement between eastern and western Germany were also observed in the German representative volunteer survey of 2014 and have been explained by the long history of Germany’s separation, differences in unemployment rate, economic performance, and demographic change [33]. Given that food banks’ assistance was largely based on volunteer labor, the number of available volunteers is a main pillar in the establishment of a food bank. The odds of reporting a lack of volunteers increased with increasing working time per volunteer, indicating that the workload of volunteers rather than the sole number of volunteers seems to be one of the limiting factors in balancing the supply and demand of existing food banks.

The volunteer-driven nature of the German Tafel is similar to food banks in other high-income countries such as Canada [28], the USA [1], and Spain [5]. In contrast to food banks in these countries, the German food banks neither involve the public sector nor receive food or other subsidies from the European Union or other national or international political organizations. German food banks heavily rely on surplus food donated from retailers and bakeries, whereas goods from producers or other wholesale donors constitute only a small part of the overall amount of food. This system shapes the quantity, quality, and reliability of the food to be distributed. On one side, it allows local food banks to supply fresh food such as fruits and vegetables, which are food products that food-insecure people tend to consume in particularly low amounts [29], although its health impacts are well known [34]. Moreover, it helps to prevent food being thrown away. According to a study under the authority of the Federal Ministry of Food and Agriculture from 2012, food waste from retailers accounts for 490,000 tons per year, of which around 38% are donated to charitable organizations such as Tafel food banks [35]. On the other side, the dependency of local food banks on donations of surplus food by local retailers makes the quantity, variety, and quality of available food highly unpredictable. Variations have also been observed in the nutritional quality of food distributed by food banks in other high-income countries even if they received government funding, such as U.S. food banks for The Emergency Food Assistance Program [36], but they tend to provide less fresh food [8]. Although this study is not able to evaluate the food donation systems of food banks in other high-income countries, it seems that donations from government programs might not necessarily make the amount of food more predictable.

Food banks participating in the survey reported not only a temporary lack of food but also an irregular surplus of food. More than 40% of food banks that reported this occasional surplus passed this food on to its users even if the amount was likely more than the user household could consume. Although the types of surplus food were unknown and it remained unclear whether users consumed this food or shared it with neighbors or friends, this practice forced the users to solve the problem and potentially might have unfavorable impacts on users’ diet and health, e.g., if the surplus food consists of bread and pastries. This holds particular truth given that the association between food insecurity and obesity, the food insecurity–obesity paradox, is well known [37,38]. A diet heavily reliant on food bank types of food may exacerbate existing chronic conditions such as diabetes [39]. Most of the research on the relationship between food insecurity and obesity has, however, been conducted in the USA, where a so-called monthly food stamp cycle was identified [40]. At least among subgroups

of recipients of the Supplemental Nutrition Assistance Program or residents with low income, food intake and food expenditures were shown to dramatically increase after food assistance [40,41] or after transferred income [42] and then to decrease over time before the next assistance/income. A similar monthly variability has also been observed in the use of soup kitchens [43]. Tafel users tend to visit the food bank every week [15] and this study is not able to reveal whether similar weekly cycles also exist among food bank users in Germany, but an infrequent oversupply of food approaching its best-before date for people already at high risk of being overweight or obese and food insecure [6,15] may be contraproductive and could unintentionally support periods of overeating.

Given that the odds of reporting a lack of food were neither related to the weight of total food distributed per month nor to the weight of food a user received per month, but to a decrease in the total weight of food distributed per month in 2017 compared with 2016, it appears that participating food banks tended to evaluate the quantity of the available food based on their experiences rather than on objective measures. This might contain the risk of dramatic miscalculation. Therefore, food banks and their users might benefit from reliable, user-friendly tools to assess the quantity and quality of the food distributed and from national guidelines regarding the amount and quality of distributed food. Food banks in other countries such as the USA have already applied diverse instruments to assess the nutritional quality of distributed foods by, e.g., nutrition profiling [44–46]. The impact of the implementation of such tools depends, however, on the willingness of food bank managers and of food donors to accept restrictions in the quantity and quality of food and on the limited personnel capacity of the food banks.

Just recently, public and political debate about the role of the Tafel food banks in the German welfare system has increased again [47]. Similar to other European countries [11,48,49], the Tafel movement is considered a seismograph for social developments [50,51] and changes in the number of food banks or its users have been interpreted to indicate changes in the food security rate [52]. The results of this study challenge these interpretations. Most user households relied on public welfare, but only a small part of eligible welfare recipients used a food bank. In 79 districts for which all available food banks participated in the survey, on average, 179 welfare recipients per 1000 welfare recipients and 17 residents per 1000 residents used a food bank. These numbers of usage were larger than the numbers revealed by a study in Berlin [9], but much lower than the prevalence rate of food insecurity of 4.3% (i.e., 43 per 1000 residents; margin of error at 90% confidence $\pm 1.44\%$) reported by the Food and Agriculture Organization of the United Nations for Germany [17]. Thus, the majority of food-insecure individuals do not appear to use a food bank. One of the possible manifold reasons for this mismatch might be that more than every tenth food bank participating in the survey reported limiting access to its assistance due to a lack of food. In addition, as reported by Tafel users as well as food bank workers, shame and fear of stigmatization associated with food bank use [53,54] might potentially prevent food-insecure people from seeking a food bank's assistance. Although motives for not using a food bank were not assessed by this study, participants reported that shame was a significant barrier, in particular among older people, to seeking assistance from a food bank. Furthermore, compared with other high-income countries, grocery prices in Germany are among the lowest, with budget supermarkets significantly undercutting other chains and driving down prices [55].

Nevertheless, a previous study showed that the distribution of food pantries mirrored the distribution of welfare recipients in Berlin [9], and the present study revealed that the number of food bank users was at least partly a function of the percentage of welfare recipients in the district the food bank was located in. Among all user household groups, user households receiving a low retirement or minimum social security benefits for senior citizens increased highest from 2016 to 2017. Actually, in Germany the rate of older people being at risk of falling into poverty has steadily increased over the last few years [56], whereas the unemployment rate has decreased [57].

Limitations

One of the major limitations of this study is the limited reliability of participants' responses. All data collected by the survey relied on self-reports. Given that food banks focus on the distribution of food and are driven by volunteers, some food banks were not able to provide detailed records, for instance, of the weight of food or the number of users. Additionally, there are no national standard procedures of data collection, and the data presented here might be subject to estimation errors.

Potential changes in the number of users and the weight of distributed food per month were retrospectively requested, which increases the risk of memory bias. The cross-sectional design of the study precludes the drawing of causal relationships.

Given that food banks participating and those not participating in the survey did not differ in location characteristics, it can be assumed that the results are representative for all food banks in the federal umbrella organization Tafel Deutschland. Due to the heterogeneity of food banks in many other characteristics, however, some uncertainty about the representativeness of any food bank sample remains.

Results of the additional services provided by the participating food banks might also give an incomplete picture of services offered in the context of the Tafel, since a service was only recorded if it was administered by the participating Tafel itself. However, there were services located in the same facility as the food bank but being provided by other organizations, which were not recorded.

Lastly, the latest data of the number of welfare recipients per district were available from 2015, whereas the data collected by the survey were from 2017. Although changes in the number of welfare recipients as a percent of the population were presumably small [58], the differences in the years the data were collected should be considered carefully when interpreting the results.

5. Conclusions

The German Tafel system provides a wide range of food assistance schemes supplying food of high nutritional value and additional services with the potential to impact individuals' diet and food insecurity. It appears that changes in the number of food bank users and their source of income partly mirror changes in the at-risk-of-poverty rate and social welfare in Germany, but there obviously are unknown factors influencing the usage of food banks. The number of food bank users seems to be an inappropriate indicator of the food insecurity rate, which can be taken as a sign of the need for implementing a regular food security monitoring system.

Due to the dependency of food banks on volunteers and food donations, they are hardly a reliable food source for parts of the population who are vulnerable to food insecurity due to their socio-economically disadvantaged situation. The obvious strain between the reliance on food donations and the response to the shifting needs of food bank users entails the risk of volunteer overload and inappropriate short-term solutions such as providing users more food than needed. One solution could be collaborations with dieticians and other public health and nutrition professionals to receive support regarding the dietary needs of food bank users. However, this will only be effective if food bank users are able to use the food bank to supplement their usual diet (as is the claim of Tafel Deutschland) rather than to rely on food banks as their primary or even only source of food.

To understand contributing factors as to which individuals use a food bank and why, further research is needed. Moreover, the impact of a food bank's food assistance on an individual's diet and food security level needs to be investigated.

In general, food banks' growth and assistance should be accompanied by vigilant coalitions of the charitable food organizations, the social sector, and professionals of social, nutritional, and health sciences in order to have a working system that supports those in need and contributes to the reduction of food waste.

Supplementary Materials: The following are available online at <http://www.mdpi.com/1660-4601/15/7/1485/s1>, Table S1: Questionnaire content, developed for a representative survey among German food banks: questions, answer options, variables (selection).

Author Contributions: Conceptualization, A.S. and N.S.-B.; Formal analysis, A.S.; Methodology, A.S. and N.S.-B.; Supervision, P.T. and N.S.-B.; Writing—original draft, A.S.; Writing—review & editing, A.S., P.T. and N.S.-B.

Funding: This research received no external funding.

Acknowledgments: The authors would like to thank all food bank managers and other food bank workers for participating in the survey and the federal association Tafel Deutschland for their administrative support.

Conflicts of Interest: A.S. supported the evaluation of one of Tafel Deutschland's other projects for which she received a small honorarium. This had no role in the design of this study; in the collection, analyses, and interpretation of data; in the writing of the manuscript; nor in the decision to publish the results.

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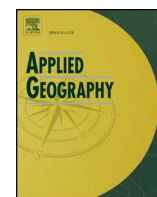
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Chapter 5

Area characteristics associated with food pantry use in Berlin – A cross-sectional ecological study

Simmet A, Stroebele-Benschop N, Tinnemann P.

Applied Geography. 2017;89:87-99. doi:10.1016/j.apgeog.2017.10.005



Area characteristics associated with food pantry use in Berlin – A cross-sectional ecological study

Anja Simmet^{a,*}, Nanette Stroebele-Benschop^a, Peter Tinnemann^b

^a Institute of Clinical Nutrition, University of Hohenheim, Fruwirthstr. 12, 70599 Stuttgart, Germany

^b Institute for Social Medicine, Epidemiology, and Health Economics at the Charité University Medical Center, Luisenstr. 57, 10117 Berlin, Germany

ARTICLE INFO

Keywords:

Food bank
Welfare
Spatial disparities
Poverty
Food environment

ABSTRACT

Although food pantries have become a crucial component of the food landscapes in many countries, so far they have rarely been included in research on the food environment. This study aims to map and analyze the relation between the proportion of adult food pantry users and child food pantry recipients as well as compositional and structural characteristics of areas in Berlin, Germany.

Publicly accessible data including the percentage of adults and children receiving welfare and those with migration background were used to characterize area composition. Investigated structural resources included the availability of discount stores, stops of the public transport as well as 44 food pantries throughout the city. Small spatial units of two incongruent spatial area data sets were denominated to characterize the 44 food pantry areas and the areas within walking distance (1000 m) to a food pantry. Linear multiple regression models were conducted to model the proportion of food pantry recipients among adults and children. Results of the study showed that the proportion of child food pantry recipients was more than twice as high compared to the proportion of adult food pantry users, with large variations between pantries. The distribution of food pantries largely mirrored the distribution of welfare recipients in Berlin. Results of multiple regression analyses suggested that the percentage of adults receiving welfare benefits and the number of stops around a food pantry were positively, and the percentage of adults with migration background was negatively related to the proportion of adult food pantry users. Among children, the percentage of children receiving welfare benefits, the number of discount grocery stores per 1000 children, and the number of stops around a food pantry were positively related to the proportion of food pantry recipients. Results of the spatial analyses can be used to improve the allocation of social and food services to support impoverished people. Future studies could investigate whether there are unmet needs of food assistance services among inhabitants with migration background.

1. Background

Morbidity risk of diseases like diabetes (Agardh, Allebeck, Hallqvist, Moradi, & Sidorchuk, 2011) or cardiovascular diseases (Addo et al., 2012; Manrique-Garcia, Sidorchuk, Hallqvist, & Moradi, 2011) as well as the risk of pre-mature mortality (Geyer, Hemström, Peter, & Vågerö, 2006; Sommer et al., 2015) follow a socioeconomic gradient and are highest among low-income and impoverished individuals. Therefore, geographical variations of poverty and associated socioeconomic factors such as receipt of welfare benefits have implications for social and health policies and civil society at large.

Given that inequalities in health cannot be entirely explained by differences in the characteristics of individuals (Diez Roux, 2007), a growing body of health research has focused on the role of the physical environment in determining health outcomes (Arcaya et al., 2016; Diez

Roux, 2007). In nutritional sciences, contextual features of areas include inhabitants' access to commercial food outlets in relation to socioeconomic characteristics (Hilmers, Hilmers, & Dave, 2012; Richardson, Boone-Heinonen, Popkin, & Gordon-Larsen, 2012), public transport (Larsen & Gilliland, 2008), and urbanization (Cummins et al., 2009; Richardson et al., 2012). Food sources of individuals with low-income, however, likely differ from those of population groups with higher income.

In Germany, the most prominent civil society actor providing food to low-income individuals is the food bank organization called "Tafel" ("table"). Food banks are defined as centralized warehouses which usually receive large quantities of foods from the industry, manufacturers and other donors and distribute these foods to smaller agencies such as soup kitchen and food pantries (Poppendieck, 1994). Food pantries are usually smaller than food banks and directly serve clients

* Corresponding author.

E-mail addresses: Anja.Simmet@uni-hohenheim.de (A. Simmet), N.Stroebele@uni-hohenheim.de (N. Stroebele-Benschop), peter.tinnemann@charite.de (P. Tinnemann).

<http://dx.doi.org/10.1016/j.apgeog.2017.10.005>

Received 8 June 2017; Received in revised form 27 September 2017; Accepted 7 October 2017
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Abbreviations

FP	food pantry
LEA	living environment area
PA	planning area
SI	social indicator
WR	welfare recipient

(Poppendieck, 1994).

Being founded in 1993 as an initiative to support homeless people (Federal Association Deutsche Tafel e.V., 2016b), today, over 920 local “Tafel” programs nationwide supply low-income people with foods donated by retailers, bakeries and manufactures (Federal Association Deutsche Tafel e.V., 2016c). Although such programs have initially emerged to provide infrequent emergency food to individuals suffering economic hardship (Bernier, Ozer, & Paynter, 2008), food banks and pantries have become a fixed part of food landscapes in many developed countries such as the U.S. (Weinfeld et al., 2014), Canada (Tarasuk, Dachner, & Loopstra, 2014), Australia (Booth & Whelan, 2014) and several European countries (Depa, Hilzendegen, Tinnemann, & Stroebele-Benschop, 2015; Lambie-Mumford, 2013; van Steen & Pellenbarg, 2014). Unfortunately, many people with low-income chronically depend on food pantry provision (Neter, Dijkstra, Visser, & Brouwer, 2014; Robaina & Martin, 2013).

Despite the increasing number of food banks and food pantries (van Steen & Pellenbarg, 2014; Federal Association Deutsche Tafel e.V., 2016a), they have rarely been included in research on the food environment of low-income population groups and all of the few existing studies were conducted in the U.S. (Algert, Agrawal, & Lewis, 2006; Caspi, Lopez, & Nanney, 2016; Mabli, Jones, & Kaufman, 2013). In Europe, the access of low-income, welfare-dependent people to food pantries remains so far largely undefined.

Moreover, while several studies investigated individual-level reasons and determinants of (long-term) food pantry use including job loss, living in a large household, an increase in housing costs, and/or food insecurity (Bhattarai & Duffy, 2003; Daponte, 2000; Kicinski, 2012), so far nothing is known about the structural and compositional characteristics of the environment being related to food pantry use.

A deeper understanding of the relationship between characteristics of the urban area around food pantries including the socioeconomic composition, commercial food outlets and public transport system and food pantry use might contribute to a more comprehensive picture of the environment in which economically deprived groups acquire their food. Since food pantry users suffer from a high level of food insecurity (Neter et al., 2014; Tarasuk & Beaton, 1999), even compared to other low-income groups (Bhattarai, Duffy, & Raymond, 2005;

Kirkpatrick & Tarasuk, 2009), this knowledge could be useful for the allocation of intervention measures and strategies to assist economically disadvantaged people by improving their food security level.

This study focuses on food pantries in Berlin, the capital of Germany, and has two research objectives. First, it maps and analyzes the spatial distribution of urban food pantries in relation to the socio-economic composition of the areas surrounding the pantries, the distribution of commercial discount grocery stores and stops of the public transport net in Berlin. Second, the study investigates the relationship between these compositional and structural environmental factors and the proportion of adult food pantry users and child food pantry recipients.

2. Methods

2.1. Study area and food pantries

The study area includes the city state of Berlin, with a population of about 3.5 million inhabitants in 2014 (Statistical Office for Berlin-Brandenburg, 2015a).

The “Berliner Tafel” project “LAIB und SEELE” is managed in a food pantry style and in 2014, it provided groceries to clients at 45 distribution points mainly located in parochial facilities (Berliner Tafel e.V., 2014). People fulfilling the “Berliner Tafel” self-defined eligibility criteria, i.e. having an income at or below the federal unemployment pay II, receive groceries including mainly fresh fruits, vegetables, and bread for a symbolic contribution of one or two Euro once a week (Berliner Tafel e.V., 2016).

Individual residential addresses were allocated to one food pantry by food bank officials, mostly according to residents' zip code (Berliner Tafel e.V., 2016). Exceptions were addresses from 18 of a total of 120 zip code areas allocated via a combination of the zip and district code. Addresses of six zip code areas were allocated to the nearest food pantries. The term *food pantry area* is used for the area covering all addresses allocated to a food pantry. Clients can use one food pantry only. Addresses of the 45 food pantries and residential zip codes and districts allocating residential addresses to individual food pantries were obtained from the “Berliner Tafel” food bank (Berliner Tafel e.V., 2016).

Due to organizational reasons very few addresses (40 of 388,724) were allocated to one of the 45 food pantries, therefore this food pantry was excluded from further analyses.

During food pantries' opening hours, user statistics including the number of adult users and the number of child food pantry recipients defined as the number of children in the user household are anonymously recorded regularly. Adult food pantry users are also called adult recipients, whereas the child analogue is only called child

Table 1
Descriptive statistics of 44 food pantries in Berlin, Germany.

	All 44 FPs	Mean	SD	Relative SD	Median
number of users	10,505	238.8	107.38	44.97	224.0
number of user households	5946	135.1	54.07	40.02	123.5
number of adult users	7473	169.84	69.09	40.68	154.0
number of child food pantry recipients	3036	69.0	45.09	65.35	57.50
children among users in %	28.90	26.97	9.13	33.85	28.22
number of users/1000 inhabitants	2.95	3.75	2.4	64.00	3.27
number of adult users/1000 inhabitants aged ≥ 18 yrs.	2.47	3.09	1.75	56.63	2.73
number of child recipients/1000 children aged < 18 yrs.	5.64	7.32	6.24	85.25	5.21
number of users/1000 welfare recipients	16.81	22.19	13.37	60.25	18.13
number of adult users/1000 adults aged ≥ 15 yrs receiving welfare recipients	15.62	20.43	12.00	58.74	17.81
number of child recipients/1000 children aged < 15 yrs receiving welfare benefits	20.74	28.17	20.88	74.12	20.38

FP: food pantry; SD: standard deviation.

recipients since children do not use a food pantry on their own. Aggregated data per month were made available for further analyses by the food bank “Berliner Tafel e.V.”

2.2. Socio-economic data

The last publicly available data on welfare benefit recipients (Senate Administration for Health and Social Affairs, 2015b, 2015a; Statistical Office for Berlin-Brandenburg based on data of the Federal Employment Agency, 2015), inhabitants with migration background (Statistical Office for Berlin-Brandenburg, 2015b), and inhabitants (Statistical Office for Berlin-Brandenburg, 2015a) were available for the end of 2014. The number of recipients of six distinct types of welfare benefits (social indicators, SI), as listed in additional Table 1, as well as the number of inhabitants with migration background in 2014 for the level of the planning areas (PA; see below) were included in the analysis. Five of the six types of welfare benefits were for adults and one type (social security benefits for children) was for children aged less than 15 years. Due to individual data protection, data for three welfare benefit types (continuous subsistence payments, minimum security benefits due to the inability to work, and minimum security benefits in older age) were not available for up to 69 PAs with very low numbers of inhabitants (< 1100 inhabitants). For the other types of welfare benefits, data were available for all 447 PAs. Recipients of any of these benefits were eligible to use a food pantry.

Inhabitants with migration background included the following individuals: individuals with foreign or undetermined nationality, individuals with German nationality but either born outside of Germany or with certificate of naturalization, children of foreigners born in Germany, children under the age of 18 years of whom at least one parent has a certificate of naturalization (Statistical Office for Berlin-Brandenburg, 2014).

2.3. Data of discount grocery stores and public transport

In Germany, the type of commercial food retailers with the highest amount of individual spending in 2014 was the discount grocery store (EHI Retail Institute, 2014). Discount grocery stores offer a limited assortment of products at low prices and may be a particular important food source of low-income individuals, for whom costs of foods are one of the most important factors of store choice (Hirsch & Hillier, 2013).

The selection of the six chains of low-budget discount grocery stores (“Aldi”, “Lidl”, “Penny”, “NORMA”, “Netto”, “Netto-Markendiscount”) was based on their annual turnover in 2013 (EHI Retail Institute, 2016). Addresses of the discount grocery stores in Berlin were gathered from the companies’ websites in June 2016 (ALDI Einkauf GmbH & Co. OHG, 2016; Lidl E-Commerce International GmbH & Co. KG, 2016; NETTO ApS & Co. KG, 2016; Netto Marken-Discount AG & Co. KG, 2016; Norma Lebensmittelfilialbetrieb Stiftung & Co. KG, 2016; PENNY Markt GmbH, 2016). Public transport stops (“Verkehrsverbund Berlin-Brandenburg”) including latitudes and longitudes were obtained via the open data portal of Berlin from the traffic association Berlin-Brandenburg (Nov–Dec 2014) (Transport association Berlin-Brandenburg VBB, 2014).

2.4. Geographical data

In Berlin, so-called living environment areas (lebensweltlich orientierte Räume, LEA) are used to plan and monitor demographic and social developments (Börmann, Jahn, & Nelius, 2006). The LEA are hierarchically divided into three levels with planning areas (PAs) being the unit on the lowest level. On average, every PA covers approximately 7500 inhabitants (Börmann et al., 2006). To estimate socioeconomic data for geographic areas different from PAs (e.g. the food pantry area), addresses were used in these analyses as the smallest available spatial unit of the different spatial distributions.

The address data set including several variables such as street name and number, PA number, x- and y-coordinates for two coordinate reference systems as well as shape files of district borders were obtained via the open data portal of Berlin from the statistical office Berlin-Brandenburg (Statistical Office for Berlin-Brandenburg, 2015c). The road shape-file was obtained from OpenStreetMap (Geofabrik GmbH and OpenStreetMap Contributors, 2016).

2.5. Data preparation and spatial analyses

The addresses of the Berlin food pantries and discount grocery stores were included in the address file covering Berlin addresses and including x- and y-coordinates, street name, street number, zip code, the identity number of the district, and the ID of the PA. For each address of food pantries and discount grocery stores, the x- and y-coordinates as well as the ID of the PA were searched based on street name, street number and zip code. This procedure resulted in exactly one match per address. The address data set including x- and y-coordinates and attributed data calculated as described below was imported as comma separated values (csv-) file into the freely available GIS application QGIS (version 2.12.0 Lyon) (QGIS Development Team, 2016a). Residential addresses, addresses of the food pantries and addresses of the discount grocery stores were mapped by the x-y-coordinates (coordinate reference system: EPSG 25833). Public transport stops were mapped by latitude and longitude by using MMQGIS (Minn, 2015). Two measures of distance of the food pantries to public transport stops were calculated as sensitivity analyses: the distance of the food pantry to the nearest stop were calculated by shortest path analyses (road distance) (QGIS Development Team, 2016b) and the mean of the straight-line distance to the three nearest stops were calculated by a summary distance matrix. Availability of stops was assessed by the numbers of stops within a straight-line radius of 500 m (Euclidean buffer) around the food pantries. The size of this buffer is based on the fact that 86% of Berlin inhabitants live within a radius of 300–400 m around a transportation stop (Center Nahverkehr Berlin, 2016). People might be unwilling to walk a further distance from a station to the target.

In order to define socioeconomic characteristics of the area within walking distance to a food pantry differed from the whole food pantry area, an area with a radius of 1000 m (Euclidean Buffer) was defined around each food pantry, and for each food pantry addresses allocated to the food pantry within this radius were identified. The size of the Euclidean buffer was chosen based on the assumption that users may be willing to walk a maximum of about 15 min to their homes, which corresponds to around 1000 m.

2.6. Statistical analyses

To obtain the total number of adult welfare recipients for each of the 447 PAs, the number of recipients for each of the five welfare benefit types for adults was summed up. The other welfare type represented the number of children aged less than 15 years receiving social security benefits for children. Incongruent spatial distribution was resolved as follows, exemplified for the number of adult welfare recipients:

At first, the mean number of welfare recipients per address within a PA was estimated for 388,684 addresses. In three PAs including 149 addresses and 191 inhabitants, no or very few recipients of welfare benefits were living and these addresses were excluded from further analyses. Thus, the total number included in the analyses was 388,535 addresses. Then, the number of welfare recipients within a food pantry area was estimated by summing up the number of addresses within a food pantry area weighted by the number of welfare recipients per address per PA.

In a similar procedure, the number of welfare recipients, inhabitants with migration background and inhabitants living within the radius of 1000 m around the food pantry was estimated.

For all food pantries, data were analyzed per distribution unit in 2014. A distribution unit is the unit each client was allowed to use the food pantry which usually was once per week. Some food pantries, however, allowed clients to use the service only once every two weeks. Although these food pantries were open once per week, every single client was allowed to use the food pantry only once every two weeks. Hence, the number of distribution units in year 2014 was 52 for food pantries allowing clients to use their service once per week and 26 for food pantries allowing clients to use their service once every two weeks.

Mean, median and standard deviation were calculated for the total number of food pantry users, the number of adult food pantry users, and the number of child food pantry recipients as well as the proportion of adult users defined as the mean number of adult food pantry users per 1000 inhabitants aged 18 years or older living in the food pantry area per distribution unit and the proportion of child food pantry recipients defined as the number of child food pantry recipients per 1000 inhabitants younger than 18 years of age living in the food pantry area per distribution unit.

The percentage of adults aged 15 years or older receiving welfare benefits, the percentage of children aged 14 years or less receiving welfare benefits, the number of discount grocery stores per 1000 adult inhabitants aged 18 years or older, the number of discount grocery stores per 1000 inhabitants younger than 18 years, street distance of a food pantry to the nearest stop in meters, mean straight-line distance of a food pantry to the three nearest stops in meters, and the number of

stops within a radius of 500 m around a food pantry were also analyzed by descriptive statistics for the whole city state of Berlin and for the food pantry area.

The percentage of adults/children receiving welfare benefits and those with migration background living within walking distance (1000 m) to the food pantry their addresses were allocated to was determined.

To investigate whether there were differences in the socioeconomic characteristics between the area within walking distance (1000 m) around a food pantry and the entire food pantry area, the percentage of adults/children receiving welfare benefits and the percentage of adults/children with migration background living within walking distance was compared to those living in the whole food pantry area by paired t-tests.

In order to better understand the internal correlation structure of the explanatory variables, Pearson correlation analyses were conducted. Separate correlation analyses were also conducted for each explanatory variables and food pantry use.

We tried parametric as well as well non-parametric regression models, but since relationships could be sufficiently described in linear terms, separate multiple linear regression models with backward elimination based on Akaike's information criterion (Symonds & Moussalli, 2011) were calculated for each of the both dependent variables, which were the proportion of adult food pantry users (dependent variable 1) and the proportion of child food pantry recipients (dependent variable 2). Explanatory variables to model

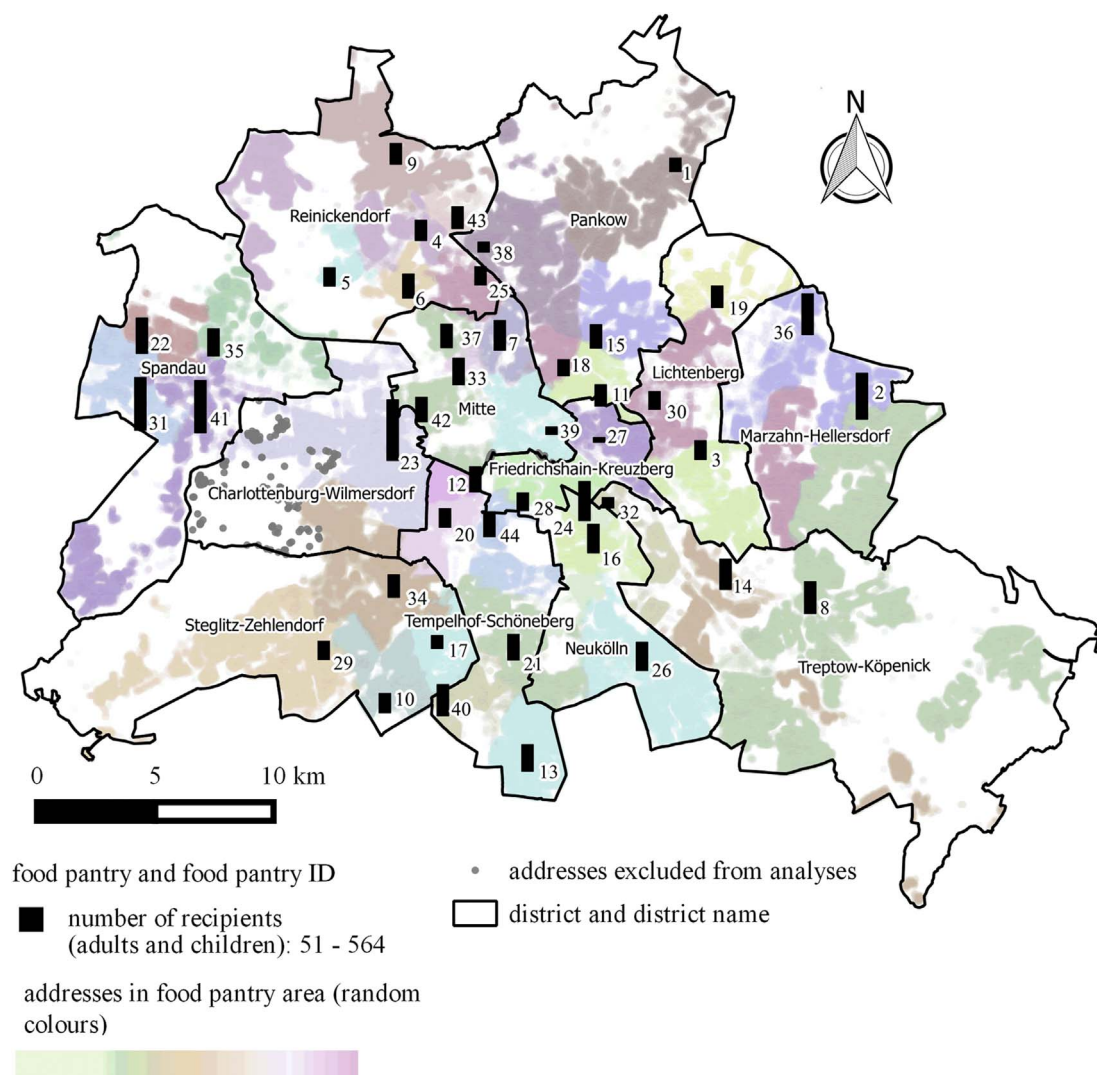


Fig. 1. The spatial distribution of the number of food pantry recipients in Berlin, 2014.

dependent variable 1 (= model 1) included the percentage of adults aged 15 years or older receiving welfare recipients, the percentage of adults with migration background, the number of discount grocery stores per 1000 adults, street distance of a food pantry to the nearest stop in meters, mean straight-line distance of a food pantry to the three nearest stops in meters, and the number of stops within a radius of 500 m around a food pantry. Explanatory variables to model dependent variable 2 (model 2) were the percentage of children aged 14 years or less receiving welfare benefits, the percentage of children with migration background, the number of discount grocery stores per 1000 children, and the last three variables also used in model 1. To deal with spatial autocorrelation (calculation of Moran's I resulted in rejection of the null hypothesis that there is no spatial autocorrelation for use by adults ($p < 0.001$), whereas for the proportion of child food pantry recipients, the null hypothesis could not be rejected ($p = 0.209$)), the mean of the x- and y-coordinates of the addresses allocated to a food pantry were included in the models. Based on the results of the bivariate correlation analyses, we initially included following interaction terms in the models: the percentage of adults/children receiving welfare benefits and the percentage of adults/children with migration background, the percentage of adults/children with migration background and the number of grocery discount stores per 1000 adults/children, street distance of the food pantry to the next transport stop/straight-line distance to the next three transport stops and number of stops within a radius of 500 m around the food pantry.

Data cleaning, preparation and visualization were performed by Microsoft Excel 2007. Statistical analyses were performed using R, version 3.2.1 (R Core Team, 2015) and Harrell Miscellaneous (Harrell Jr and with contributions from Charles Dupont and many others, 2015). Values were considered significant at $p < 0.05$.

3. Results

3.1. Food pantry use

Detailed statistics of food pantry use are shown in Table 1. In 2014, 10,505 individuals from 5946 households visited one of the 44 food pantries per distribution unit, whereby nearly 29% of all recipients were children. With 48 to 405 adult recipients and 3 to 191 child food pantry recipients, large variations in the number of recipients were observed between the food pantries with the highest number registered by a food pantry in the western district Charlottenburg (see Fig. 1 and see also standard deviations in Table 1). The total number of food pantry recipients accounted to nearly three recipients per 1000 inhabitants.

The proportion of adult food pantry users was two adult users per 1000 adult inhabitants and the proportion of child food pantry recipients was almost six child food pantry recipients per 1000 inhabitants under the age of 18 years. Fig. 2 shows the proportion of adult food pantry users and the proportion of child food pantry recipients over all 44 food pantries.

Large variations between the areas allocated to the 44 food pantries were observed (range: 0.44–7.49 adult users per 1000 adult inhabitants) with relatively high proportions of adult food pantry users in the north-eastern districts, parts of the north-eastern district as well as parts of the south of Berlin (Fig. 3). A similar spatial distribution was observed for the proportion of child food pantry recipients (Fig. 4), but variations were even wider (range: 0.19–24.74 child food pantry recipients per 1000 children).

Considering welfare recipients only, nearly 17 of 1000 welfare recipients used a food pantry in 2014. Again, the mean number of adult users per 1000 adult welfare recipients was lower than the mean number of child food pantry recipients per 1000 children receiving welfare benefits (Table 1).

3.2. Descriptive statistics of explanatory variables

Descriptives of the explanatory variables per address, for the area allocated to a food pantry, for the area within a radius of 1000 m around a food pantry along with the data for the entire city state of Berlin are shown in Table 2.

The percentage of adults aged 15 years or more receiving any kind of welfare benefits as well as the percentage of adults with migration background were much lower than those of children. More than every fourth (27.22%) of 537,952 children living in Berlin received welfare benefits and nearly every second child (45.74%) had a migration background in 2014.

The number of discount grocery stores per 1000 adults and per 1000 children was 0.19 and 1.04, respectively. On average, the road distance of the food pantry to the next transport stop and the straight-line distance to the next three stops were not more than 260 m. For all explanatory variables, large variations between food pantry areas were observed as indicated by large standard deviations.

The areas within walking distance to the food pantries (1000 m) were characterized by higher shares of adult welfare recipients ($t(43) = -2.78$, $p = 0.008$), of children receiving welfare benefits ($t(43) = -2.59$, $p = 0.013$), of adults with migration background ($t(43) = -2.61$, $p = 0.0125$), and of children with migration background ($t(43) = -2.67$, $p = 0.0108$) compared to the entire food pantry areas. Overall, 36.32% of adults aged 15 years or more receiving welfare benefits, 38.00% of children aged 14 years or less receiving welfare benefits, 34.96% of adults with migration background, and 34.95% of children with migration background lived within walking distance to the food pantry their address was allocated to.

3.3. Correlation analyses

The correlation analyses revealed a strong association between the percentage of adults receiving welfare benefits and the percentage of adults with migration background ($r = 0.72$; $p < 0.001$). The same hold true for the percentage of children receiving welfare benefits and the percentage of children with migration background ($r = 0.73$; $p < 0.001$). For adults and children, the higher the percentage of individuals with migration background, the lower was the number of discount grocery stores per 1000 individuals in a food pantry area (adults: $r = -0.59$; $p < 0.001$; children: $r = -0.57$; $p < 0.001$). In addition, there were positive correlations between the distance measures of the food pantry to the next transport stop and the next three transport stops respectively ($r = 0.60$; $p < 0.001$) and negative correlations between both the distance measures and the number of stops within a radius of 500 m around a food pantry ($r = -0.40$ and -0.65 ;

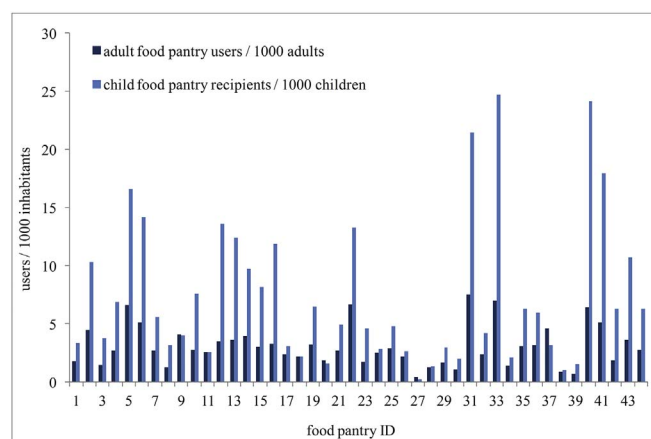


Fig. 2. The number of adult food pantry users and children food pantry recipients per 1000 adults and children, respectively in Berlin, 2014.

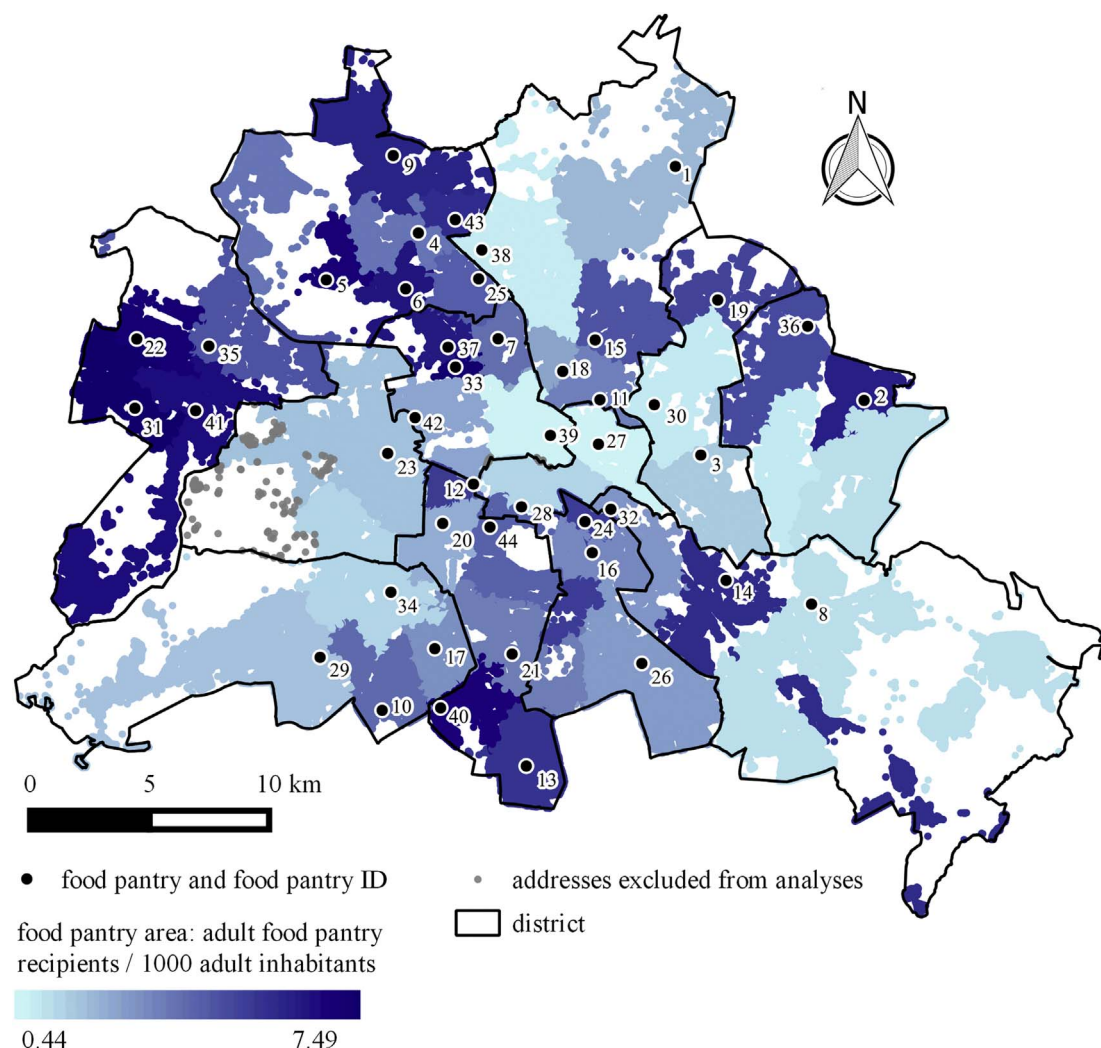


Fig. 3. The spatial distribution of adult food pantry users in Berlin, 2014, Note: white areas are unbuilt; an area is defined by the addresses a food pantry is allocated.

$p < 0.001$ and $p = 0.003$, respectively).

3.4. Multiple regression and spatial distributions of final variables

The results of the multiple regression model 1 are shown in Table 3. The final four variables selected through the backward selection approach included the percentage of welfare recipients aged 18 years and older, the percentage of inhabitants with migration background aged 18 years and older, the number of stops within a radius of 500 m around the food pantry, and the mean x-coordinate of the addresses allocated to the food pantry. None of the interaction terms and none of the distance measures of the food pantry to the next or the next three transport stops remained in the final model.

The percentage of adults receiving welfare benefits was positively related to the proportion of adult food pantry users, whereas the percentage of adult inhabitants with migration background was negatively related to use indicating that the higher the percentage of adult inhabitants with migration background living in the food pantry area the lower the food pantry use rate by adults (Table 3). In addition, the number of transportation stops within a radius of 500 m around a food pantry also was negatively related to use. The explained variance accounted to 50% (adjusted $R^2 = 0.50$; $p < 0.001$). There was no indication of multicollinearity as indicated by variation inflation factors lower than 10.

The spatial distributions of the final explanatory variables to model the proportion of adult food pantry users are shown in Fig. 5. The

northern and southern parts of the inner city were the food pantry areas with the highest percentage of adults receiving welfare benefits, whereas for the percentage of adults with migration background, higher values were observed in the western than in the eastern parts of the city. The number of stops was higher in the inner parts of the city than in the peripheral areas (Fig. 5).

The results of the multiple regression models 2 are shown in Table 4. Of the final four variables, the percentage of children receiving welfare benefits and the number of discount grocery stores per 1000 children were positively related to the proportion of child food pantry recipients, whereas the number of transport stops within a radius of 500 m around a food pantry was negatively, albeit not significantly related to the dependent variable. The percentage of explained variance was with 38% (adjusted $R^2 = 0.38$; $p < 0.001$) much lower than the variance explained by model 1.

As shown in Fig. 6, the spatial distribution of the percentage of children receiving welfare benefits was similar to the distribution of adult welfare recipients. There tended to be more discount grocery stores per 1000 children in the eastern parts of the city with the exception of parts of the western districts Spandau and Reinickendorf.

4. Discussion

By using freely accessible public-use data, we were able to calculate and map spatial distributions of nearly all adults and children receiving welfare benefits, those with migration background, as well as the

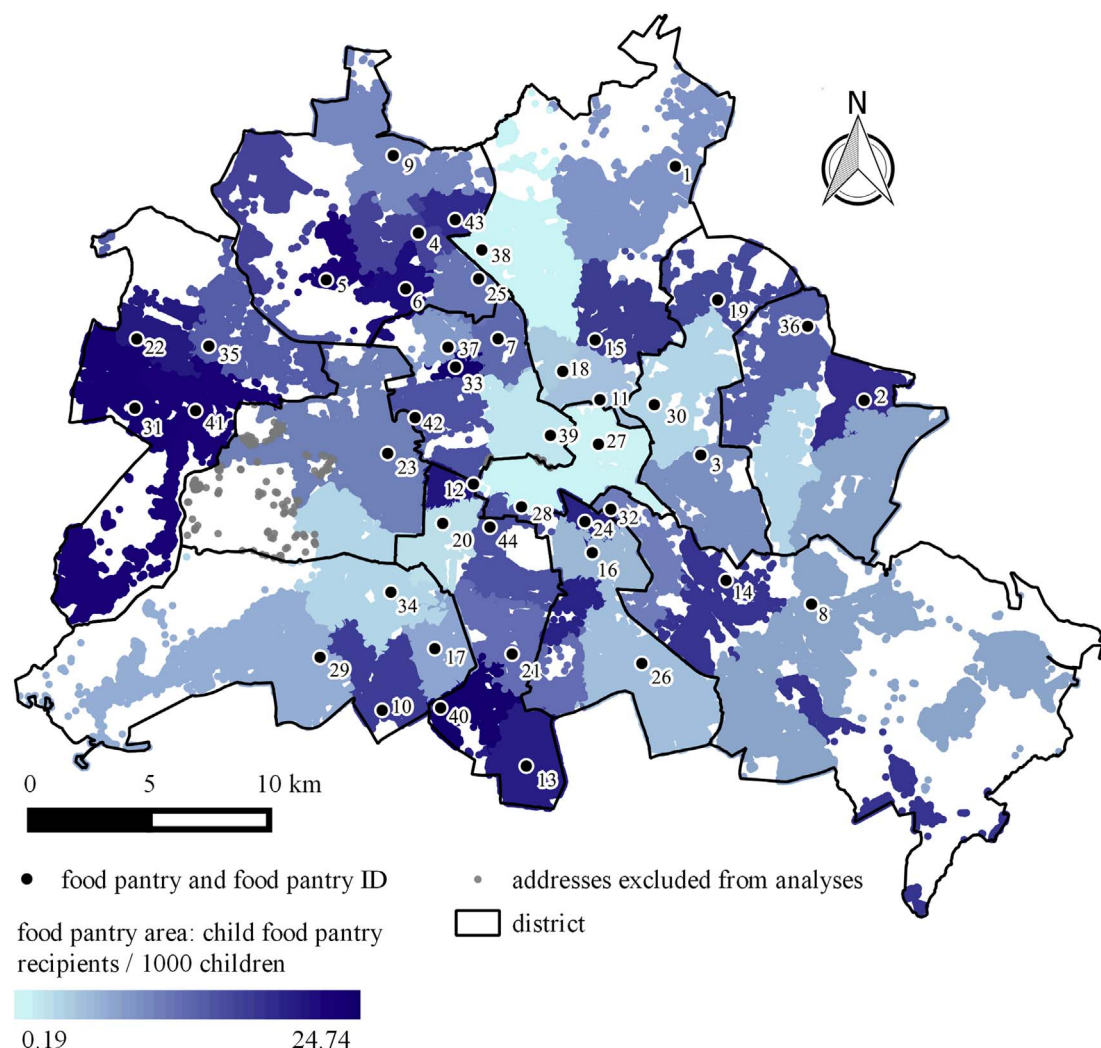


Fig. 4. The spatial distribution of child food pantry recipients in Berlin, 2014, Note: white areas are unbuilt; an area is defined by the addresses a food pantry is allocated.

Table 2

Mean, standard deviation and median of the explanatory variables.

	Area allocated to each food pantry			Area within a radius of 1000 m around each food pantry			Entire city of Berlin
	mean	SD	median	mean	SD	median	
number of addresses	8834	8518	5794	1680	578	1636	388535
number of inhabitants under the age of 18 yrs.	12230	6326	10970	3676	1800	3382	537952
number of inhabitants aged 18 yrs or more	68720	40416	60570	20360	9548	19010	3023682
% of adults receiving welfare benefits	16.70	7.51	13.80	18.17	7.57	16.44	15.83
% of children receiving welfare benefits	33.43	29.09	16.91	36.45	17.43	36.17	27.22
% of adults with migration background	25.47	13.01	23.05	26.83	12.69	25.50	25.51
% of children with migration background	46.23	19.93	43.26	48.65	19.55	48.31	45.74
number of discount grocery stores/1000 children	1.04	0.43	0.92	/	/	/	/
number of discount grocery stores/1000 adults	0.19	0.07	0.18	/	/	/	/
distance of a food pantry to the nearest stop in meters	184	113	185	/	/	/	/
mean distance of a food pantry to the three nearest stops in meters	254	81	232	/	/	/	/
number of stops within a radius of 500 m around a food pantry	4.96	2.00	5.00	/	/	/	/

SD: standard deviation.

number of discount grocery stores and stops of public transport in metropolitan Berlin along with food pantries. Noticeable spatial differences in the distribution of these variables could be observed. For the first time, this study, moreover, examined the relation between structural and compositional variables and food pantry use from a socio-spatial perspective for Germany.

4.1. Food pantry use

This study found a very low use of food pantries among adults and relatively low proportion of child food pantry recipients, although the latter one was more than twice as high as the use by adults. The observed higher proportion of children receiving assistance from a food

Table 3
Outputs of multiple regression models examining the relation between the proportion of adult food pantry users and several explanatory variables.

	β	95% CI	B	p-value	VIF
percentage of adult welfare recipients	0.17	0.09, 0.25	0.74	< 0.001	2.53
percentage of adult inhabitants with migration background	−0.08	−0.13, −0.03	−0.58	0.002	2.64
number of transport stops within a radius of 500 m around a food pantry	−0.24	−0.45, −0.04	−0.28	0.020	1.15
mean x-coordinate of addresses allocated to a food pantry	−0.0001	−0.0002, −0.0001	−0.67	< 0.001	1.26

β : unstandardized regression coefficient; CI: confidence interval; B: standardized regression coefficient; VIF: variation inflation index.

pantry was paralleled by a higher percentage of children receiving welfare benefits and a higher percentage of children with migration background than among adults. Previously, children were identified as a population group with a particular high risk of poverty (Statistic departments of the federation and the federal states, 2016; Statistical Office for Berlin-Brandenburg, 2016) and results of this study indicated that children may also be at higher risk of reliance on food pantry use. It remains, however, unclear whether households with children suffer more often from food insecurity or whether they use food pantries at an earlier level of food insecurity than households without children.

From studies conducted in Canada (Tarasuk et al., 2014), France (Castetbon et al., 2011), the Netherlands (Neter et al., 2014), the UK (Lambie-Mumford, 2013), as well as in Germany (Depa et al., 2015) it is known that the majority of food pantry users relied on public welfare benefits. With around 17 users per 1000 welfare recipients, only a very small proportion of eligible welfare recipients, however, used any Berlin food pantry in 2014. Prevalence of food pantry use among low-income and food insecure populations in other countries such as in Canada (Kirkpatrick & Tarasuk, 2009; Loopstra & Tarasuk, 2012) and in the U.S.

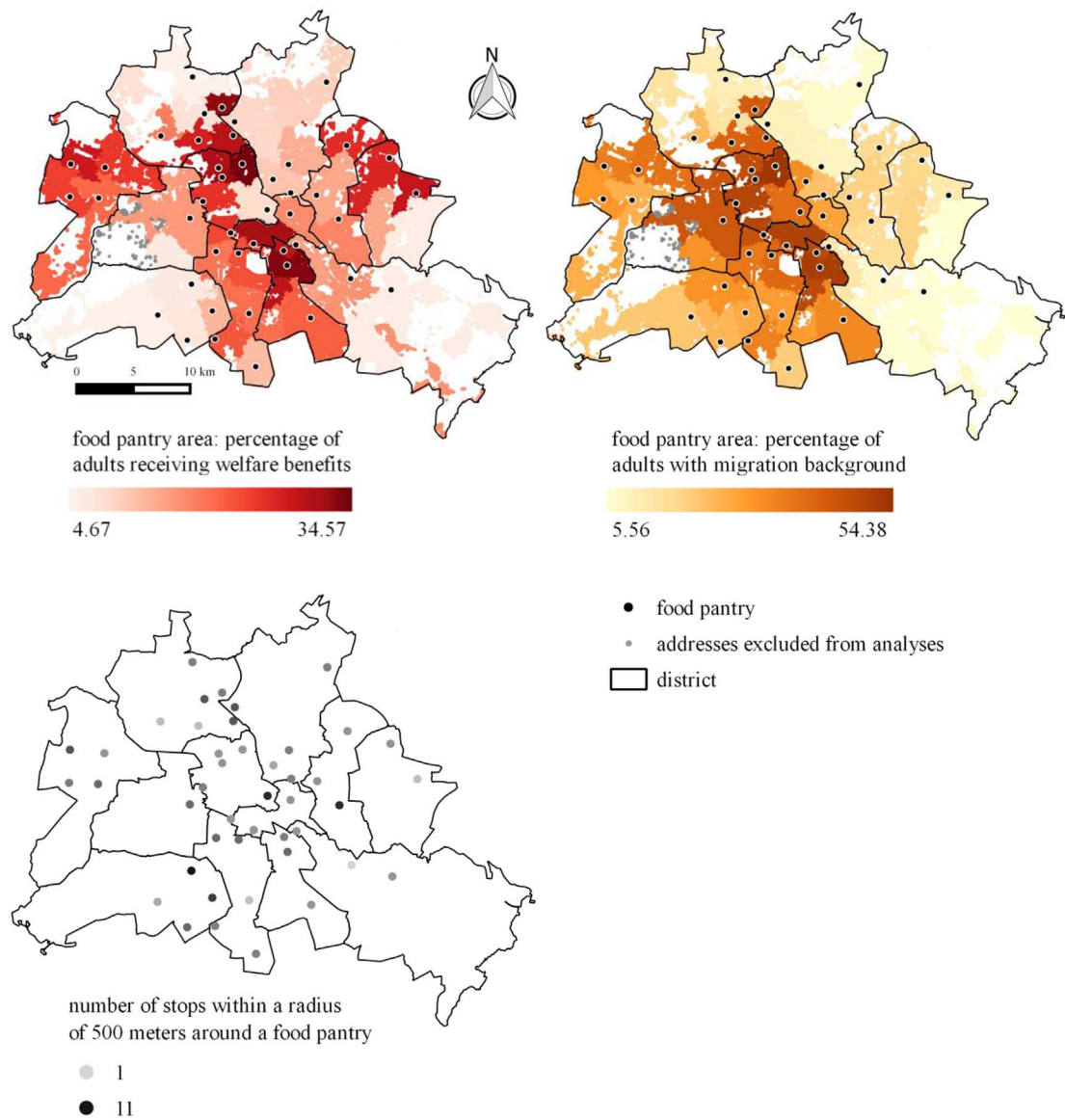


Fig. 5. The spatial distributions of explanatory variables to model the proportion of adult food pantry users in Berlin, 2014, Note: white areas are unbuilt; an area is defined by the addresses a food pantry is allocated to; the number of stops is defined as the number of stops within a radius of 500 m around a food pantry.

Table 4

Outputs of multiple regression models examining the relation between the proportion of child food pantry recipients and several explanatory variables.

	β	95% CI	B	p-value	VIF
percentage of children receiving welfare benefits	0.16	0.06, 0.26	0.43	0.002	1.17
number of discount grocery stores per 1000 children	5.65	1.41, 9.89	0.39	0.010	1.41
number of transport stops within a radius of 500 m around a food pantry	−0.63	−1.45, 0.19	−0.20	0.126	1.15
mean x-coordinate of addresses allocated to a food pantry	−0.0005	−0.0007, −0.0003	−0.60	< 0.001	1.33

β : unstandardized regression coefficient; CI: confidence interval; B: standardized regression coefficient; VIF: variation inflation index.

(Coleman-Jensen, Rabbitt, Gregory, & Singh, 2016) was much higher (6%–23%, i.e. 60–230/1000 individuals). While methodological issues may partly contribute to this result, we calculated mean number of users, while the other studies assessed prevalence of any food bank/food pantry use in the last 12 months, the main reason for the divergent rates might likely be explained by the notable differences in welfare systems. Payments of the German social security system cover all essential necessities and guarantee livelihood for each citizen independently of age and nationality (Alesina & Glaeser, 2006), which may result in a reduced need of food bank's assistance than in countries with a more liberal welfare system.

Moreover, the German food bank and pantry system “Tafel” claims to provide supplemental foods only (Federal Association Deutsche Tafel e.V., 2012) rather than foods for a full meal plan for a determined number of days as intended by many U.S. and Canadian food pantries (Jessri, Abedi, Wong, & Eslamian, 2014; Weinfield et al., 2014). Items provided include mainly fresh fruit and vegetables, bread and in a lower amount dairy products (Federal Association Deutsche Tafel e.V., 2012), while U.S. and Canadian food pantries traditionally provide more canned products, packed cereals as well as boxed noodles, rice and ready-to-eat meals (Weinfield et al., 2014; Willows & Au, 2006).

4.2. Spatial analyses of food pantries

This study used a very small spatial unit, the residential address, to calculate compositional characteristic of the food pantry areas, which

were different from the PAs defined for monitoring purposes. This procedure was possible since the homogeneity of socio-economic structures within a PA was one of the most important criteria to define PAs' boundaries (Bömermann et al., 2006).

Given that for both adults and children, measures of welfare recipients and the measures of migration background tended to be higher when considering the area within a radius of 1000 m around a food pantry than the entire food pantry area, many food pantries tended to be located in neighbourhoods where the need of their assistance is presumably particularly high. However, even when the percentage of welfare recipients in the food pantry area was moderate, the absolute number of welfare recipients can be relatively high resulting in a high absolute number of users such as in the food pantry in the western district Charlottenburg.

Over one third of all welfare recipients, who were eligible to use a food pantry, were estimated to live within walking distance (1000 m) of the food pantry allocated to their residential address. Interestingly, an U.S. study revealed that only 9% of 490 food pantry users lived in walking distance (800 m) to the food pantry (Algert et al., 2006). Since we were, however, not able to identify users' residential addresses, the percentage of users living within walking distance to the food pantry their residential address is allocated to remains so far unknown.

4.3. Relationships between explanatory variables and food pantry use

The proportion of adult food pantry users and the proportion of

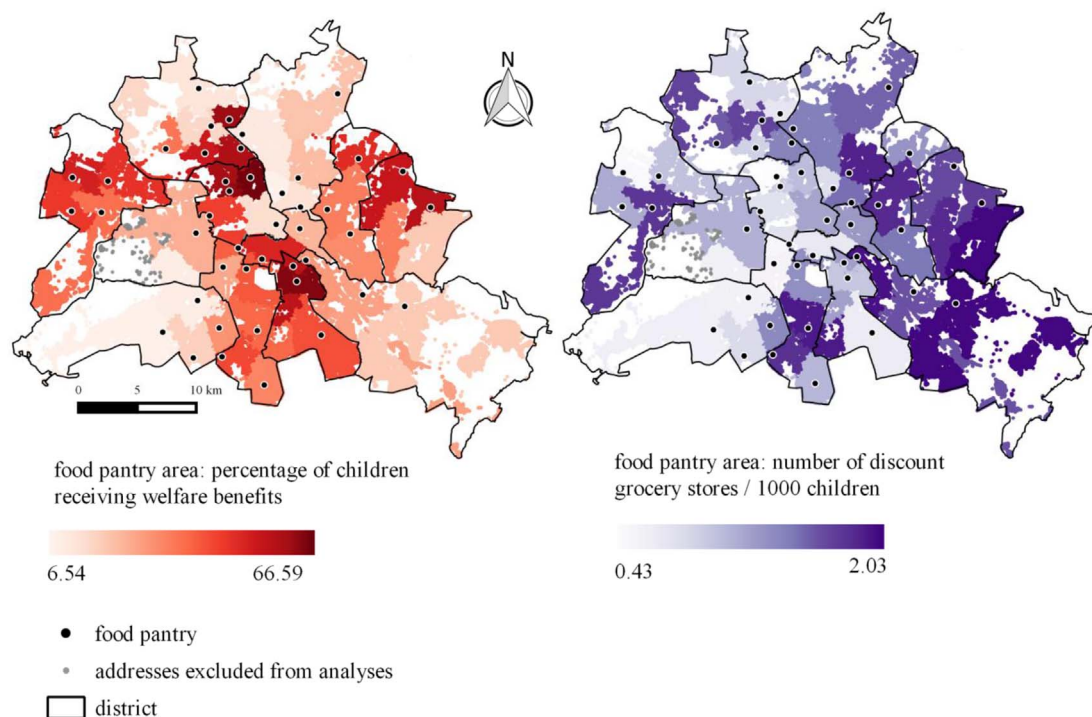


Fig. 6. The spatial distributions of explanatory variables to model the proportion of child food pantry recipients in Berlin, 2014. Note: white areas are unbuilt; an area is defined by the addresses a food pantry is allocated to; the spatial distribution of the number of stops within a radius of 500 m around a food pantry is shown by Fig. 5.

child food pantry recipients were highest in the western districts Spandau and Reinickendorf as well as in some north-eastern and southern areas of Berlin. According to the latest social structure atlas in 2013, Spandau as well as the north-eastern district Marzahn-Hellersdorf were characterized by high unemployment rates, low incomes, high risks of poverty and below-average life expectancies (Meinlschmidt, 2013).

Among adults and children, the percentage of welfare recipients living in the food pantry area was significantly related to the proportion of food pantry recipients. Surprisingly, the percentage of adults with migration background was negatively related to food pantry use by adults when holding the percentage of adults receiving welfare benefits constant. Given that in 2014 most inhabitants with migration background had Turkish origins (Statistical Office for Berlin-Brandenburg, 2015b) who often have a Muslim religious background, the localisation of Berlin food pantries in parochial facilities of Christian communities may contribute to this finding. Although the Berlin food bank and its pantries are open to anyone in need independently of religion (Berliner Tafel e.V., 2016), Muslims may have reservations to go to Christian communities to receive food. In other countries such as in the UK, Muslim charities provide food bank programs as well (Forrest, 2014), but we are not aware of any Muslim food bank in Berlin or even in Germany.

Other potential explanations for this finding are suggested by results of US studies, which found that, for migrants, social networks and informal borrowing arrangements play an important role in coping with food insecurity (Borre, Ertle, & Graff, 2010; Quandt, Arcury, Early, Tapia, & Davis, 2004). Whether these coping strategies are more prevalent among German inhabitants with migration background than among those without migration background or whether other differences in coping strategies contribute to our observations is, however, so far unclear.

The number of discount grocery stores per 1000 children was positively related to the proportion of children living in households that used a food pantry, whereas the percentage of children with migration background as well as an interaction term between both explanatory variables dropped out of the final model. This study is not able to prove causality of this result. The positive relationship between the number of discount grocery stores per 1000 children and the proportion of child food pantry recipients may become more understandable when considering the few previous German studies investigating disparities in access to commercial food outlets. A previous small scale study in Berlin found, for instance, a higher number of grocery stores in districts of a low social index than in districts of a high social index and no differences in variety or price of fruit and vegetables (Stroebele, Dietze, Tinnemann, & Willich, 2010). Similarly, a study conducted in Cologne found a higher number of outlets offering fruit and vegetables (as well as fast food outlets) in economically deprived areas than in wealthier ones (Schneider, Diehl, & Gruber, 2013) indicating that at least in German urban areas, access to food outlets may be better in areas of low socioeconomic characteristics than in those of higher ones. In contrast, in other countries, particular in the USA, areas of lower socioeconomic characteristics tend to have fewer commercial food outlets than wealthier ones (Franco, Diez Roux, Glass, Caballero, & Brancati, 2008; Gustafson, Hankins, & Jilcott, 2012).

A representative study in the USA found that 25% of census tracts without a supermarket had at least one food pantry (Mabli et al., 2013). The percentage even increased to 40% when considering high-poverty tracts only. In the USA, food pantries may, therefore, play a major role in addressing food access limitations (Mabli et al., 2013), whereas in Germany, food pantries are seen as additional food source supplementary to commercial food outlets for low income population groups.

The negative relationship between the number of stops within a radius of 500 m around a food pantry and the proportion of adult food pantry users and child food pantry recipients may be explained by the finding, that, not surprisingly, the number of stops was higher in inner

areas with a higher population density than in peripheral areas of Berlin.

More than 26 years after the reunification of Germany, obvious differences were also seen in the spatial distribution of the percentage of adults and children with migration background with a clear western-eastern pattern. In contrast, the number of discount grocery stores per 1000 children or adults tended to be higher in the eastern districts, in particular in the peripheral ones, than in the inner city and western part of Berlin (eastern-western pattern).

An analysis of the societal and political roots of these patterns is beyond the scope of this study, but it is important to recognize the different histories of the western and eastern part of Berlin when interpreting the results of this study.

It is, for instance, well known that there still remain differences in consumer characteristics and behaviour including disposable income, favourite shops, favourite brands, shopping frequency and spending between the western and eastern part of Germany (Fuchs-Schündeln, Krueger, & Sommer, 2010; Institut für angewandte Marketing- und Kommunikationsforschung GmbH, 2016). Potential differences in attitudes towards using a food pantry between people living in the western and eastern part of Berlin (Germany) are, however, so far unidentified.

One might object that multicollinearity could contribute to the results detected by the regression analyses given that some high bivariate correlation coefficients were found between independent variables, for instance between the share of adults receiving welfare benefits and the share of adults with migration background. However, all values of the variation inflation factor were clearly lower than 10 and even lower than 4. These values would indicate multicollinearity as reported in the literature (O'Brien, 2007). Moreover, the regression coefficients did not have large standard errors which also would indicate multicollinearity (Alin, 2010). By sequentially excluding highly correlated independent variables, none of the remaining coefficients changed dramatically which confirmed that multicollinearity does not play an important role in the models. Finally, we used mean-centred variables to define interaction terms to reduce multicollinearity between the interaction terms and the corresponding single independent variables (for a discussion see, for instance: Echambadi & Hess, 2007)). Results of all of these procedures indicated that multicollinearity was not a considerable problem in our regression analyses.

4.4. Limitations

This study included welfare data for most PAs covering nearly the entire city of Berlin, but given that for up to 69 PAs data for three welfare types were not available, some uncertainty of the results should be considered. However, the number of inhabitants of any of these PAs was very small (< 1100) (Meinlschmidt, 2013) and given the small percentage of recipients of continuous subsistence payments and minimum social security benefits in the PAs for which data were available (number of inhabitants > 1100), the number of recipients in the 69 PAs is presumably very small.

The number of adults and children receiving welfare benefits per address was calculated by dividing the number of adults and children receiving welfare benefits living within a PA by the number of addresses within the PA, assuming that welfare recipients were homogeneously distributed across addresses within a PA. The same was assumed for the number of inhabitants and for the number of inhabitants with migration background. This might contain the risk of some uncertainty, as it was neither possible to adjust for the actual number of individuals living at each address nor could the precision of the estimation be validated. In contrast to administrative spatial units, the 447 PAs were, however, explicitly defined as “real life” living areas and, as cited above, homogeneity of socio-economic structures within a PA was a crucial criteria to define PAs' boundaries (Bömermann et al., 2006). Moreover, the results are in accordance with findings of the Statistical Office for Berlin-Brandenburg (Statistical Office for Berlin-

Brandenburg, 2016). Therefore, the applied method presumably resulted in the best estimate of the number of welfare recipients, the number of inhabitants and the number of inhabitants with migration background for different spatial distributions.

While many studies investigating access to commercial food outlets relied on the cut-off of 1000 m to define walking distances (Apparicio, Cloutier, & Shearmur, 2007; Larsen & Gilliland, 2008), the distance individuals are willing to walk to a food pantry is largely unidentified. Previous food environment research found large variations in investigated outcomes between buffers of various sizes (Thornton, Pearce, Macdonald, Lamb, & Ellaway, 2012). Since it was not possible to geo-code users' residential addresses in this study, neither the real distance individuals travelled to food pantries nor the mode of transportation could be determined.

A further limitation of our study is the use of straight-line buffers rather than road network buffers to estimate the number of welfare recipients living within walking distance to a food pantry and to define buffers around public transport stops. In contrast to Euclidean buffers, network buffers are calculated by measuring a defined distance along the pedestrian street network in all buffers possible directions away from – in our case-food pantries. However, complete routable network layers were not freely accessible for Berlin. We therefore decided to calculate Euclidean buffers recognizing that network buffers would be more precise. Due to a high density of roads and pathways in urban areas such as Berlin, the difference between straight line buffers and network buffers, however, is presumably small.

The addresses of the commercial discount grocery stores were gathered from companies' websites without validating the addresses with other sources. This may contain the risk of error if companies' websites would be not complete or up-to-date.

Finally, the number of children receiving welfare benefits was related to inhabitants under the age of 15 years, whereas the other data for children were related to inhabitants under the age of 18 years. For this reason, there remained some discrepancies in these data sets, which we were not able to solve.

5. Conclusion

The examined 44 food pantries of the Berlin food bank tended to be located in areas housing population groups on welfare benefits and provide a well-suited network for welfare recipients living across the entire city. However, large variations were observed in the absolute as well as relative number of adult and child food pantry recipients.

A high share of adults and children receiving welfare benefits was the most profound factor related to a high proportion of adult and child food pantry recipients. At first, this result challenges the claim of the German federal welfare system to cover all essential necessities including enough food. However, given that on average only 17 per 1000 Berlin welfare recipients used any food pantry in 2014, receiving welfare benefits is not a sufficient condition of food pantry use. Moreover, the regression models in our study explained only 50% and 38% of the observed variance in food pantry use indicating that there may be additional unidentified individual and environmental variables contributing to the variance in food pantry use.

Nevertheless, this study has relevance for different stakeholder

groups involved in food banking, the provision of social or food services and/or other community services as well as for researchers. Confronted with the results of the study (May 2017), the food bank organization, for instance, now plans to open a new food pantry nearby an overloaded food pantry in the western district Charlottenburg. Results and illustrations of this study are also helpful for the food bank organization to convince communities to provide facilities in areas with overloaded existing food pantries or with greater potential need of food pantry service.

For providers of social or food services or other community services, results of this study may be used to identify vulnerable population groups being at risk of food insecurity and to allocate intervention measures to assist impoverished people in achieving food security.

Besides these practical implications, future studies are recommended to close following research gaps: First, further studies may investigate potential interacting individual and environmental roots of food pantry use at larger scales including rural and urban areas.

Second, the proportion of child food pantry recipients was much higher than the proportion of adult food pantry recipients indicating that relatively more households with children sought assistance from a food pantry than those without children. Factors contributing to this finding are so far unstudied. However, the potential impacts of food insecurity during childhood are well known (Ryu & Bartfeld, 2012) and, therefore, future studies urgently need to provide a deeper understanding of the relationships between food insecurity, receiving assistance from a food pantry, and health impacts among children.

At last, the percentage of adults with migration background tended to be negatively related to food pantry use among adults when controlled for the percentage of adult welfare recipients. Future studies may identify individual reasons of inhabitants with migration background to decline food pantry use and investigate potential unmet needs of charitable food assistance among inhabitants with migration background.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Declarations

Ethics approval and consent to participate

Not applicable.

Availability of data and materials

The datasets analyzed during the current study are available from the corresponding author on reasonable request.

Acknowledgements

The authors would like to acknowledge Sabine Werth, Brigitte Zunker-Jacob, and Stefan Sramkiewicz from the Berliner Tafel e. V. for providing the user statistics.

Additional table 1. Studied welfare benefit types with eligibility criteria

Welfare Benefit Type	Eligibility criteria
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unemployment pay II	<ul style="list-style-type: none"> • aged between 15 and 65 yrs and • capable of working and
social security benefits for children	<ul style="list-style-type: none"> • having no income or an income below the federal cut-off • aged < 15 yrs or under and • living in a “needs unit” (household) with at least one welfare recipient who is capable of working
social security benefits for adult people not capable of work	<ul style="list-style-type: none"> • aged ≥ 15 yrs and < 65 yrs and • not being capable of working and • living in a “needs unit” (household) with at least one welfare recipient who is capable of working
continuous subsistence payments	<ul style="list-style-type: none"> • asylum seekers living at least 15 months in Germany or • individuals not eligible to receive other welfare benefits
minimum security benefits	<ul style="list-style-type: none"> • aged between 18 and 64 yrs. • not being capable of working at the long-term (permanently)
minimum security benefits in older age	<ul style="list-style-type: none"> • aged ≥ 65 yrs. • having no income or an income/retirement pay below the federal cut-off

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Chapter 6

Discussion and limitations

The main objectives of this thesis were to summarize the existing evidence about the dietary quality among food pantry users and to explore the different levels of influencing factors of the dietary quality among food pantry users in high-income countries. In the following, at first the key findings of the presented publications and their main limitations will be briefly illustrated. Then, the results of this thesis will be categorized into the socio-ecological model as presented in chapter 1 and potential mechanisms by which the factors at the different levels might influence the diet of food pantry users will be discussed. Finally, the common limitations of the studies will be described.

6.1 Summary of key findings

6.1.1 The dietary quality of food pantry users: a systematic review of existing literature

The review presented in chapter 2 revealed that the mean group intake of energy, F&V, dairy products, and calcium did not meet recommendations among reviewed food pantry users. Even if the mean group intake was within recommendations, large percentages of the study samples consumed a diet low in vitamins A, C, D and B vitamins, iron, magnesium and zinc. In addition, reviewed food pantry users had, in particular, a lower consumption of dairy products compared to the general population. However, it has to be considered, that the diverse dietary assessment methods applied in the reviewed studies relied only on self-reporting. The problem of misreporting was considered in very few reviewed studies which might limit the comparability and the validity of the outcomes (cf. Poslusna et al.¹). Moreover, to be included a study must reported the adequacy of dietary intake either by comparing intake of energy, foods and/or nutrients with food-based dietary guidelines or dietary reference values, or by scoring dietary intake using indices. However, only one study assessed the overall dietary quality by using the Healthy Eating Index,² whereas the others compared intake of energy, foods and/or nutrients with guidelines. This latter approach does not allow the evaluation of the overall dietary quality (see explanation box 2). Finally, a broad criterion was used to define eligible participants, since they must have used a food pantry only once in the last 12 months. Although many food pantry users chronically visit a food pantry at least once a week,³⁻⁵ results of the studies included in the review did not necessarily reflect the dietary quality among regular food pantry users.

6.1.2 The nutritional quality of food provided from food pantries: a systematic review of existing literature

The review presented in chapter 3 demonstrated, firstly, that the nutritional quality of reviewed food bags provided by food pantries were highly variable and, secondly, that the nutritional quality of most

reviewed food bags was low as reflected, in particular, by a lower provision of dairy products, vitamins A and C and calcium than national dietary recommendations. None of the studies investigated, however, the overall nutritional quality of the food provided, for instance, by using indices. Moreover, it has to be considered that most of the studies were from the USA and Canada and none of the studies was nationally representative and therefore, they did not reflect the nutritional quality of food provided by food pantries in general.

6.1.3 The German food banks and its users – a cross-sectional study

The study presented in chapter 4 revealed that the German food bank system Tafel Deutschland provided a comprehensive net of food pantries, social supermarkets, food banks and other services to low-income people. One of the most critical advantages of Tafel in Germany compared to similar organizations in many other high-income countries was the distribution of large amounts of perishable foods rather than non-perishable foods. However, due to the dependence on donors such as retailers, the amount of food distributed was highly variable. Given the volunteer driven nature of the Tafel, a lack of volunteers was one of the most important struggles of the organization.

Given that the Tafel participating in the survey and those not participating in the survey did not differ in the type of community, of residents living in the district the Tafel was located in, or in the number of welfare recipients living in the district the Tafel was located in, results of this survey can be seen as representative for all Tafel associated to Tafel Deutschland. It has to be considered, however, that participants' responses were of unknown reliability, since there were no national standard procedures to record any user, food or other data.

6.1.4 Area characteristics associated with food pantry use in Berlin – A cross-sectional ecological study

The study presented in chapter 5 revealed firstly that the Berliner Tafel e.V. provided a well-suited net of food pantries throughout the city, although large variations in the absolute and relative number of adults and child food pantry recipients have been observed. Secondly, the study supported results of the study presented in chapter 4 that food pantry usage was partly a function of the percentage of welfare recipients at area-level. In addition, food pantry usage by adults was negatively related to the percentage of inhabitants with migration background, i.e. the people without a migration background are less likely to use the Tafel. Usage was also negatively related to the number of stops of the public transport within a 500 meter radius around the food pantry. Food pantry usage by children was positively related to the number of discount grocery stores per 1000 children and was also negatively related to the number of stops of the public transport within a radius of 500 meters around the food pantry. Given its ecological design, this study was, however, not able to establish any causal interferences. Thirdly, food pantry usage tended to be low in Berlin compared to other districts of

Germany and to other high-income countries. This study was, however, not able to explain this finding.

6.2 Synthesis of the presented studies

As illustrated in chapter 2, the dietary quality of food pantry users in high-income countries tended to be low. In this chapter, results of the four presented publications will be classified according the Social Ecological Framework (SEM) of McLeroy et al. (cf. chapter 1, see figure 2) and potential mechanisms by which the factors at the different levels might influence the diet of food pantry users will be illuminated. Given the research subjects of the presented articles, the main focus will lie on the organizational and community levels as well as on the level of public policy.

At the intra-individual level, the review presented in chapter 2 confirmed results of other studies that were not included in the review (see chapter 1) demonstrating that food pantry users in high-income countries had a low income, received mostly welfare benefits and were unemployed. Moreover, they were often food insecure and belonged to ethnic minorities. The study presented in chapter 4 revealed that in Germany, most Tafel users were also depended on public welfare.

Although the review did not prove any causal relationships, it has well been recognized that the intra-individual factors characterizing food pantry users were related to a poor diet. For instance, a low income was shown to be related to a high consumption of refined grains and added sugar.⁶ One of the explanations might be that a healthier, nutrient-dense diet was related to higher costs than a energy-dense, nutrient-poor diet.⁷ Unemployment mostly led to a critical decrease in household income. While few studies investigated the impact of unemployment on diet, a Danish longitudinal study of 3440 households found that long-term (more than seven months) unemployment led to a substitution of nutrients by carbohydrates and added sugar.⁸

As demonstrated in explanation box 1, food insecurity has repeatedly been demonstrated to be related to a lower dietary quality even when controlled for income (see also Leung et al.⁹).

With regard to the interpersonal level, the review presented in chapter 2 also supported results of other studies that were not included in the review (see chapter 1) by showing that food pantry users in high-income countries often were singles or single parents. This fact was also mirrored by a small study from the USA that measured different types of social support among 53 food pantry users.¹⁰ Among other sub-constructs of social support, the participants scored lowest for “companionship”, i.e. the type of support that gives someone a sense of social belonging. The authors assumed that the low score for “companionship” was rooted in the fact that the majority of the sample was single or living alone.¹⁰ Although in this study, social support was not significantly related to food insecurity - probably due to the small sample size¹⁰ - other studies of low-income populations found a significant relationship between social support and food insecurity at cross-sectional.^{11,12} Moreover, at least in general

populations, social support has repeatedly been demonstrated to be related to the diet quality^{13,14} or F&V consumption.¹⁵

At the organizational level, i.e. at the level of the food pantries, the review presented in chapter 3 revealed that food pantries in high-income countries did not provide a full meal-plan. In addition, the presented articles highlighted the heterogeneity of food pantries between and within countries. The German Tafel share some common characteristics with food pantries and food banks in other high-income countries such as the volunteer-driven nature (compared to food pantries in the USA,¹⁶ Canada,¹⁷ Australia,¹⁸ and other European countries^{19,20}) and the dependence on food donors (compared to food pantries in USA,¹⁶ Canada,¹⁷ Spain²⁰ or France²¹), but there are also some differences. For instance, the German Tafel system distributes mainly fresh produce such as F&V, baked goods such as bread, dairy products and meat and alternatives (see chapter 4), whereas food pantries in the USA and Canada mainly focus on non-perishable food (see chapter 3). Similar to the German Tafel system (see chapter 4), the food banks in Israel also distribute mainly perishable food such as F&V.^{22,23} After conducting the review published in chapter 3, a study from Israel compared the content of 90 food baskets distributed by 16 food pantries to the recommended number of portions and nutrients requirements.²² Not surprisingly, the baskets provided nearly all portions of F&V (87%), but less than one third of the baskets met the recommendations for minerals and vitamins, except for vitamins A and C.²² Thus, even food pantries focusing on perishable food do not cover all nutrients in appropriate amounts.

Given the low dietary quality observed among food pantry users (see chapter 2), it remains the central question whether using a food pantry has an impact on the dietary quality. Might using a food pantry even be harmful?

Very few studies investigated this issue. For instance, the aforementioned recent study from Israel examined the relationship between the nutritional quality of the food baskets distributed by food pantries and the recipients' dietary quality.²² The nutritional quality of the food distributed as indicated by an index called "basket healthy portion score" was positively related to the recipients' dietary quality assessed by an individual nutrient density score.²² A recent German study of 52 socioeconomically disadvantaged men found that regular food pantry users consumed a significant larger variety of F&V than those who were not or infrequently using a food pantry.²⁴ Confirming these results based on cross-sectional designs, a recent longitudinal study compared a single-day dietary pattern the day before and after visiting a food pantry among a convenience sample of 455 food pantry users in six states of the USA and found that dietary variety increased the day after the pantry visit among participants.²⁵ In contrast, the overall diet quality did not improve. The authors assumed that quantity rather than quality might be of a concern to food pantry providers²⁵ (cf. chapter 3). However, the study did not adjust for the source of food consumed, i.e. the authors did not examine whether the

food consumed was received from a food pantry, from multiple food pantries and/or from commercial food stores.

A recent study overcame this limitation by assessing the contribution of food received from a food pantry on total dietary intake.²⁶ The authors investigated the nutrient intake of 112 food pantry users in Texas (USA) by comparing their diets composed of food from food pantries, other sources and the total combined consumption (food from food pantries and other sources).²⁶ The study found that the food received from a food pantry provided more than 55% of the energy consumed as well as more than 50% of the total intake of refined and whole grains, F&V, dairy products, protein food, and meat.²⁶ Moreover, the food received from the food pantries significantly increased total dietary intake of several micronutrients. Despite the food donations, the mean dietary intake of whole grains and dairy products as well as of carbohydrates, poly-unsaturated fatty acids, dietary fiber, and several micronutrients was, however, less than recommended, whereas the mean daily energy intake was 60 kcal above recommendations.²⁶ The authors concluded that the low intake of dairy products and whole grains was due to the food pantry users' refusal to take these products when offered.²⁶

Taken together, these recent results confirmed the results of the review presented in chapter 2 and found a low dietary quality among food pantry users. However, although the studies were not without limitations – in particular a potential self-selection bias,²² and the cross-sectional design^{22,24,26,27} or very short follow-up²⁵ - it appears that the food distributed by food pantries might assist users in improving their diet. In other words, the dietary quality of beneficiaries might be even lower without the support from food pantries.

The mechanisms through which pantries' food provision might influence users' diet are, however, not yet well understood. Beyond the direct nutritional value of the food provided, food pantries' assistance is likely to relieve users' financial budgets. For instance, food pantry users may buy additional food items to make their meal "complete."²⁸ However, this issue has so far rarely been investigated.

In addition to a direct nutritional and a financial value, food pantries might improve users' dietary quality by educational means. As described in chapter 4, around 45% of the Tafel in Germany provided at least one additional service related to food, nutrition, or cooking such as a delivery service for mobility impaired elderly or disabled clients, fellowship with coffee and cake during the hours of food distribution, and/or extras like recipes. Providing food preparation tips and recipes, in particular tailored ones, resulted in greater vegetable use among food pantry users in Virginia, USA.²⁹ Other nutrition-related interventions at food pantries such as cooking classes and/or nutrition education have also been shown to be effective in increasing the quality of the diet and improving cooking skills among the participants³⁰ or decreasing body mass index.³¹

At the community level, the studies presented in chapters 4 and 5 revealed that Tafel Deutschland and the Berliner Tafel e.V. provided a widespread net of food pantries and food banks in Germany and

Berlin respectively. However, the density of Tafel, i.e. the number of Tafel per 10,000 welfare recipients, was lower in the eastern compared to the western parts of Germany.

Although the relationship between access to a food pantry and diet has so far not been investigated, results of studies on the relationship between access to retail food and diet might give reasons for concern. A systematic review found moderate evidence that the local food environment including access has a causal impact on diet.³² However, most of the included studies had been conducted in the USA,³² where inequalities in food access have repeatedly been documented by comprehensive reviews (see chapter 1).^{33,34} Outside the USA such as in Germany,^{35,36} Australia,³⁷ the UK,^{38,39} and New Zealand⁴⁰ no or minimal differences or the exact opposite have been found, i.e. deprived areas have the greatest access to healthy foods. These findings might also explain the positive relationship between the discount grocery stores and child food pantry recipients in Berlin as observed by the study presented in chapter 5.

A study in the USA revealed that households of food pantry users with greater access to food pantries, defined as the number of food pantries in a certain area, were less likely to be food insecure.⁴¹ A systematic review, however, demonstrated that only three of five studies found a significant association between the local food environment and households' food security level.⁴² Moreover, most of the research on the food environment has so far been cross-sectional in design and therefore has not been able to establish causal interferences.

At the level of public policy, the studies presented in chapters 4 and 5 gave empirical support to articles discussing a temporal relationship between the broader socio-political context and the rise of food banks and food pantries (see chapter 1). In both studies, Tafel usage was partly a function of the percentage of welfare recipients living in the area the Tafel was located in. Also in other countries, welfare recipients appear to be at a particularly high risk of using a food pantry.^{43,44}

Mirroring the increasing rate of older people at risk of poverty in Germany,⁴⁵ from 2016 to 2017, the number of user households receiving a low pension or minimum security benefits in older age increased significantly more than the number of households with other income (see chapter 4). Although most Tafel users relied on some type of public welfare, on average, only 179 out of 1000 welfare recipients and 17 out of 1000 residents overall used a Tafel (calculation based on 79 districts for which all available Tafel participated in the survey, see chapter 4). Given that the Food and Agriculture Organization of the United States reported a prevalence of food insecurity of 4.30% (i.e. 43 residents per 1000 residents),⁴⁶ the majority of food insecure residents likely do not use a Tafel. A similar mismatch between the prevalence of food insecurity and food pantry use was observed in a study from Toronto (Canada), where only 21.5% of 484 low-income families had used a food pantry, whereas 65.3% of the sample had been food insecure.⁴⁷ It seems, firstly, that most food pantry users were welfare recipients, but not all welfare recipients were food pantry users. Secondly, most food

pantry users were at a high risk of being food insecure (see chapters 1 and 2), but not all food insecure people used a food pantry.

The direct influence of welfare policies on individuals' diet has rarely been investigated. Most of the few studies examined the potential impact of the Supplemental Nutrition Assistance Program on individuals' diet⁴⁸ and food security in the USA.⁴⁹ In Germany, researchers found that the amount of the unemployment pay-out (Arbeitslosengeld II) provided for the nutrition of children and adolescents was insufficient to realize an optimal balanced diet in 2004.⁵⁰ Although this amount has increased since then,⁵¹ results of the study presented in chapter 4 revealed that the number of underage beneficiaries of the Tafel's assistance had increased from 2016 to 2017.

In addition to the public welfare systems, others policies may directly or indirectly influence food pantry users' diet. For instance, the French national assembly passed a law that ban supermarkets from throwing away or destroying unsold foods.⁵² Instead, supermarkets must donate surplus food to charities such as food banks or for animal feed. However, the impact of these policies on the dietary quality among food pantry users has, so far, not been investigated.

In summary, several factors at the individual, social, and environmental level might influence the dietary quality of food pantry users (see figure 2). The exact interacting mechanisms are so far, however, not fully understood.

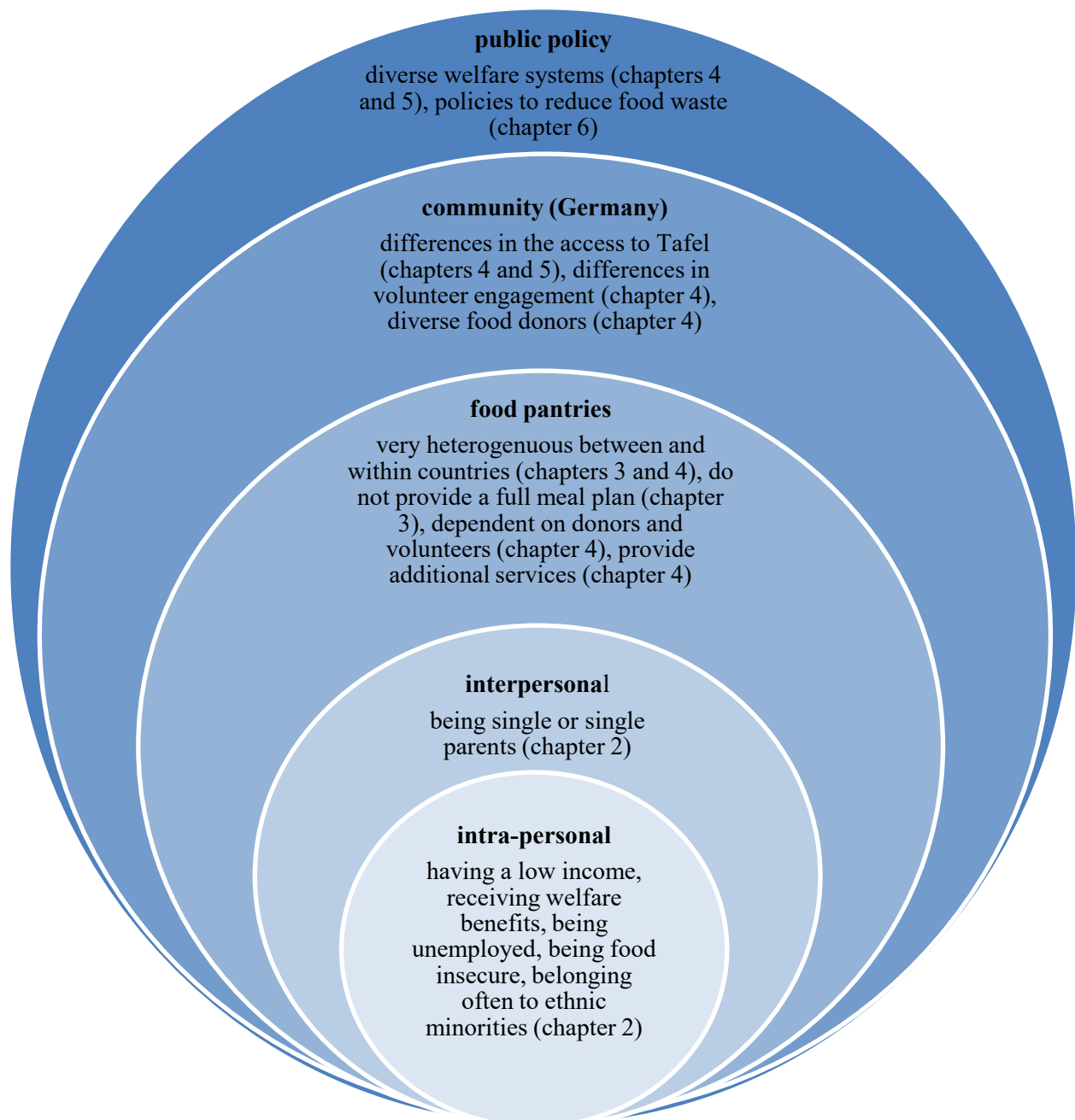


Figure 2. A social ecological model adapted for the dietary quality among food pantry users (simplified), adapted from “An ecological perspective on health promotion” by McLeroy KR, Bibeau D, Steckler A, Glanz K, 1988.⁴⁸

6.3 Limitations of the presented studies

One of the most important limitations of the presented studies is their cross-sectional design, which does not allow the identification of any causal relationships.

The joint reflection of the presented studies is limited by the heterogeneity of the applied study designs (two reviews, i.e. no original studies, one cross-sectional study applying a comprehensive survey and one cross-sectional ecological study using secondary data and applying GIS) and the scales focused on (high-income countries, Germany, and Berlin). Although this perspective allows the identification of similarities and differences across food pantry organizations located in different countries, it has to be considered that the findings of the study presented in chapter 4 were representative for all Tafel in Germany, whereas none of the studies included in the reviews presented in chapters 2 and 3 was representative on a national level. This limits the comparability of the study results.

Another essential limitation of the studies presented in chapters 4 and 5 is the limited reliability of the data collected from food pantries. Both, the data collected via a comprehensive survey (chapter 4) as well as the secondary data (chapter 5), were initially collected from Tafel staff. Given their focus on the distribution of food rather than on statistics and their reliance on volunteers, some Tafel branches were not able to provide reliable data, for instance, of the number of users. Nevertheless, as long as reliable (digital) methods of data collection are missing (cf. chapter 7), these data provide the best possible estimate.

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Chapter 7

Implications and conclusion

7.1 Implications

This section summarizes the implications for practitioners and researchers of the four articles discussed previously.

7.1.1 Implications for practitioners

Although the food pantry and food bank systems in many countries are highly institutionalized (see chapters 1, 3, 4 and 6), they usually lack nutritional standards for the food provided. In the USA, half of the food banks participating in a national online survey reported that they used “common sense” in classifying the nutritional quality of their food inventory.¹ Also the results of the study presented in chapter 4 indicated that the Tafel tended to evaluate the quantity of the available food based on their experiences rather than on objective measures. Although other practitioners and researchers applied a nutrition-profiling system to measure the food distributed in terms of MyPyramid days² or the Healthy Eating Index,³ more food pantries and food banks are recommended to regularly monitor the amount and the nutritional quality of the food provided.

Given the high variability observed between and within the food pantries under study (see chapters 3, 4 and 5), a universal recommendation to all food pantries may be of limited value. Instead, it may be worthwhile for food pantries and food banks to consult dietitians and other health experts how to improve the validity and reliability of their food data and to identify the nutritional and social needs of food pantry users.

As a first step, Tafel Deutschland is currently planning a pilot study on the establishment of a digital logistics system which should assist local Tafel in identifying surplus food at retailers, increase efficiency in transport and improve the reliability and validity of data regarding the amount, types and specifications of food.

Given that most food pantries fail to provide amounts and types of foods that were adequate for a healthy diet for the indented number of days (see chapter 3 and 6), food pantries should rethink their intent to provide a full meal plan. Instead, it is suggested to supply foods that low-income, food insecure people usually consume in particular low amounts, such as F&V and dairy products (see the review presented in chapter 2). The observed low dietary quality and high prevalence of obesity among food pantry users in combination with the shifting usage patterns, i.e. from emergency use to chronic use, highlight the need to pay more attention to the quality rather than the quantity of the food provided. Although many food pantries still face competing interests such as concerns to jeopardize donor relationships, not wanting to decrease the amount of food provided and concerns in terms of

limiting users' choice,⁴ they are advised to implement policies to prevent or at least limit donations of unhealthy foods such as soda or sweets.⁵ Through their low-threshold services and their nationwide structures (see chapter 4) food pantries may, moreover, serve as an important setting to address nutrition-related or social topics for a population group that otherwise may be hard to reach. Given their charitable character and the dependence on volunteering (see chapter 4 and 6), they are hardly able to provide the full range of potential diet-related measures. Therefore, they are encouraged to cooperate with other institutions in this field and to contribute their valuable experiences to other institutions' professional knowledge.

7.1.2 Implications for researchers

Although several studies investigated the dietary intake among food pantry users, more attention should be given to the examination of the overall dietary quality among food pantry users (cf. explanation box 2 and chapters 2 and 6). Given that the causal impact of using a food pantry on individual's dietary quality, food security and health has rarely been investigated (cf. chapter 6), well-planned longitudinal study designs are needed to investigate these impacts. Multi-level approaches may be used to better understand the role of food pantries in the complex interplay of individual, social and environmental influences on the diet of food pantry users.

As a first step, based on results of the presented studies, the author of this thesis has started a research project in cooperation with Tafel Deutschland to gain a deeper understanding of the factors at the individual, social, and environmental levels influencing food insecurity among food pantry users.

Moreover, researchers are strongly recommended to investigate the mechanisms by which using a food pantry might impact users' dietary quality, food security and health (see chapter 6).

As the number of food pantry users seems to be an inappropriate indicator of the prevalence of food insecurity in Germany (see chapter 4 and above), the prevalence of food insecurity should be regularly monitored in the general population. Moreover, given the observed mismatch between the percentage of welfare recipients, the prevalence of food insecurity and the prevalence of food pantry use, there is a strong need to understand differentiating factors between food pantry users and non-users.

7.2 Conclusion

This thesis illustrated that the dietary quality of food pantry users tended to be low as indicated by an inadequate mean group intake of energy, F&V, dairy products and calcium and large percentages of the study samples that consumed a diet low in vitamins A, C, D and B vitamins, iron, magnesium and zinc (see chapter 2).

In addition, this thesis contributed to an enhanced understanding of factors of the individual, social and environmental levels that potentially influence the dietary quality of food pantry users (see chapters 3, 4, 5 and cf. chapter 6). The socio-ecological model was demonstrated to be a useful framework for the identification of these factors. However, several questions remained unanswered (cf. chapter 7.1). Given that the dietary quality is a critical and modifiable risk factor associated with

the chronic diseases observed among food pantry users such as hypertension and diabetes mellitus, a deeper understanding of the interacting mechanisms by which these factors might influence the dietary quality is needed. This knowledge is necessary to develop effective interventions to improve the dietary quality among food pantry users.

It was shown that the Tafel in Germany and food pantries and food banks in other high-income countries provided a broad range of services (see chapters 3 and 4). Given that food pantry users received the majority of their food consumed from a food pantry (see chapter 3 and cf. chapter 6), the food received from a food pantry likely played a critical role in their dietary quality. Although food pantries did not provide a full meal plan necessary for a healthy diet (see chapter 3 and cf. chapter 6), they may have a positive impact on the dietary quality of their users (cf. chapter 6.2).

This thesis also indicated that Tafel users represented only one part of the food insecure population in Germany (see chapter 4). Given that the Tafel is the only nationwide organization providing immediate food assistance for people struggling to meet their food needs, this result is of concern. Receiving public welfare appears to be one of the attributes of Tafel users, but not all welfare recipients use a Tafel (cf. chapter 5). A deeper understanding of the determinants of food insecurity and of factors differentiating Tafel users and non-users would be helpful to identify those who fall through the food security net. Political approaches are needed to address food insecurity on a national level.

Due to their charitable characterization, their dependence on donors and volunteers and their inability to reach all food insecure people, the Tafel and food pantries in other high-income countries should not and cannot be the sole response to food insecurity. By following the recommendations made by this thesis, they may, however, become an important organization in civil society when it comes to health promotion, at least to a subgroup of the food insecure population.

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Author's declaration

Declaration in lieu of an oath on independent work according to Sec. 18(3) sentence 5 of the University of Hohenheim's Doctoral Regulations for the Faculties of Agricultural Sciences, Natural Sciences, and Business, Economics and Social Sciences

1. The dissertation submitted on the topic "The dietary quality of food pantry users from a socio-ecological perspective" is work done independently by me.
2. I only used the sources and aids listed and did not make use of any impermissible assistance from third parties. In particular, I marked all content taken word-for-word or paraphrased from other works.
3. I did not use the assistance of a commercial doctoral placement or advising agency.
4. I am aware of the importance of the declaration in lieu of oath and the criminal consequences of false or incomplete declarations in lieu of oath.

I confirm that the declaration above is correct. I declare in lieu of oath that I have declared only the truth to the best of my knowledge and have not omitted anything.

Berlin, June 20, 2019

Anja Simmet

Appendix

Newcastle-Ottawa Scale adapted for cross-sectional studies investigating the dietary quality of food pantry users

This Newcastle-Ottawa Scale was adapted from Wells and colleagues¹ and used for the first publication: “The dietary quality of food pantry users: a systematic review of existing literature.”

1. **Selection** (maximum two stars)

1.1 Representativeness of the sample

- a. truly representative of the average socioeconomic characteristics in the target population (all subjects or random sampling) *
- b. somewhat representative of the average socioeconomic characteristics in the target population (non-random sampling) *
- c. selected group of users (e.g. volunteers)
- d. no description of the sampling strategy

1.2 Non-respondents:

- a. Comparability between respondents and non-respondents characteristics is established, and the response rate is satisfactory. *
- b. The response rate is unsatisfactory, or the comparability between respondents and non-respondents is unsatisfactory.
- c. No description of the response rate or the characteristics of the responders and the non-responders.

2. **Comparability** (maximum two stars)

Individuals in different outcome groups are comparable on the basis of the design or analysis (either by matching or by adjustment for the confounders listed)

- a. study controls for educational level *
- b. study controls for any additional factors *

3. **Outcome** (maximum one star)

Assessment of outcome (diet quality)

- a. independent and/or blind assessment *
- b. record linkage *
- c. self report, validated instrument
- d. self report, not validated
- e. no description

Newcastle-Ottawa Scale adapted for cross-sectional studies investigating the nutritional quality of food provided from food pantries

This Newcastle-Ottawa Scale was adapted from Wells and colleagues¹ and used for the second publication: “The nutritional quality of food provided from food pantries: a systematic review of existing literature.”

1. Selection (maximum one star)

Representativeness of the sample

- a. truly representative of the average content of the bags (all bags or random sampling) *
- b. somewhat representative of the average bag (non-random sampling) *
- c. selected group of bags (arbitrarily selected)
- d. no description of the sampling strategy

2. Comparability (maximum two stars)

Bags are comparable on the basis of the design or analysis (either by matching or by adjustment for the confounders listed)

- a. Study controls composition of the households the bag is given for (i.e. number of individuals, adults, children).*
- b. Study controls for number of days the bag is originate to last.*

3. Outcome (maximum one star)

Assessment of outcome (nutritional quality)

- a. independent and/or blind assessment*
- b. record linkage *
- c. standardized method (e.g. recording content of the bags)*
- d. non-standardized method (e.g. diverse volunteers who were not trained recorded the content of the bags)
- e. no description

Reference

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